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LINES OF PROGRESS IN ENGINEERING.

At a recent meeting of the American Association for the Advancement of Science Professor C. M. Woodward, president of section D—mechanical science and engineering—addressed the section upon "Lines of Progress in Engineering." He spoke of the necessity of pushing forward in all lines of work, of solving every problem as it comes up, and never retreating.

Taking up in detail some of the lines along which progress should be made, Professor Woodward spoke first of the utilization of waste energy, having particular reference to waterfalls. While at present at every vantage ground the work of utilization has begun, it should not stop here, for we should turn to the smaller streams and mountain torrents. Mountain reservoirs would serve the triple purpose of preventing destructive floods, saving the energy for useful work, and aiding irrigation. While no one can see far into the future, it is thought that the dawn of a new era of energy-saving is in sight.

Mr. Woodward then turned his attention to what he termed the clumsy steam engine. While, as is well known, the efficiency of the steam plant as an energy transformer is low, we can hardly agree with him in terming it clumsy. The great loss here is due to the system, not to the machine. The engine itself is a model of engineering design and construction. The boiler, too, taken as an absorber of heat, is an efficient device. The chief loss is not through the chimney as stated, but through the exhaust pipe, and this loss can not be prevented as long as we adhere to the steam system, which is somewhat roundabout, it is true, but we would hardly call it clumsy.

Professor Woodward anticipates great progress in prime-mover development, both in the construction of gas engines which burn fuel in the cylinder, but do not explode it, or even in the successful production of a gas turbine. In the latter direction a great step forward would be taken if some one would design an engine which would consume continuously oil and compressed air, and thus maintain a high pressure in a suitable reservoir.

Another important opening for future enterprise is thought by Professor Woodward to be the establishment of artificial centres of power, where large and efficient generating stations will be erected, from which power will be distributed for great distances in all directions. Such undertakings would have beneficial effects in more ways than one, for besides decreasing the cost of power and economizing fuel, they would remove from the cities the chief source of smoke and air contamination.

Other directions in which progress may be expected were outlined, but these are of only general interest to the electrical engineer. These include purification of rivers, tubular construction of machines, the increased use of concrete, and

aerial navigation. Under the latter head it may be said that advance is anticipated by a process of eliminating the gas bag. Aeronauts will first learn to control their machines by providing some support in the nature of a balloon. As they gain skill in this they will diminish the buoyancy of their gas bag until possibly they will be able to leave it out altogether.

Under the heading of fundamental principles, great stress is laid upon the necessity of thorough drill in these. However complete an engineering course may be, if it does not send its men away with a good grasp of the underlying principles upon which their profession is founded, the course is a failure.

Of the future, Professor Woodward takes a hopeful view. He thinks that there is a glorious and splendid era opening, and that the young engineers with clear heads and skilled hands, who are now coming to the front, are fortunate. Indeed, all who are in any way helping on the higher education, which good engineering makes possible, should be happy.

ELECTRIC LIGHTING DURING FOGS.

One of the advantages claimed for the gas-lighting system is its excellent load-factor. The plant is operated night and day at an average rate, and hence, under the most economical condition. What gas is not used during one part of the day is stored up for use when the demand increases. In fact, a gas-lighting plant has an accumulator system which smooths out all peaks, gives a high load-factor, and holds a fair reserve for unforeseen demands.

On the other hand, the electric lighting plant can store only to a limited extent the electrical energy which it is able to generate at times of light load, for use when the demands increase. While a storage battery may be used to cut off a portion of the peak, as regards the total output of the station its capacity is small; hence, the electric lighting station is under the necessity of having machine generators of sufficient capacity to supply the maximum demand which may come upon it, and it is usual to have, in addition, a certain amount of reserve to provide against accident. This necessity has been something of a drag on electric lighting installations, because of the increased expenditure for expensive machinery which will be run a short time only during the day. The average load on an electric lighting station is only about a quarter of the total available supply.

But it is, indeed, a great disadvantage which does not bring some compensation, some time or somehow. During the recent heavy and long-continued fog in England the demand for street and house lighting was so great that in certain towns the storage of gas was not sufficient to carry the gas companies over this period, and they were forced to reduce the pressure in their mains, thus, of course, decreasing the amount of illumination at the very time it was most needed. With the electric lighting companies the condition was otherwise, for what had formerly been considered as a hardship now stood them in good stead, and they were able to meet all demands, and had it not been for the arc lamps, several cities would have been practically without lighting. It is thought that this experience will result favorably for the electric lighting companies, and that electric lights in streets will be used in England much more than is now done. Even the worst fog benefits some one, for these lighting plants broke all records for daily outputs, for which, of course, they will be well paid.

THE ELECTRIC ARC.

Mr. W. Duddell, who is so widely known from his researches with the oscillograph, has been making a study of the reactions going on in the electric arc, and has come to certain conclusions which differ from those heretofore accepted.

It has been thought that there was a back or counter-electromotive force in the arc of considerable magnitude, which accounted for nearly all the drop of potential across the arc. This, Mr. Duddell finds, is not the case—that is to say, this counter-electromotive force is smaller than has been supposed. With solid carbons it amounts to about twelve volts, but with cored carbons it rises to seventeen volts or thereabouts. These figures depend, to a considerable degree, upon the kind of carbon used. For instance, with a steady arc carrying but ten amperes, the carbons being eleven millimetres in diameter, this counter-electromotive force varies between twelve and eight volts, and rises to fifteen volts if the carbons have been soaked in a solution of potassium carbonate and dried. The conductivity of the vapor column depends largely upon the impurities present. Indeed, it is supposed that if absolutely pure carbon could be obtained, its vapor would have a very high specific resistance.

To explain this counter-electromotive force, Mr. Duddell believes that it is a thermoelectric effect, and takes place at the junction of the carbon and the vapor column. There are two electromotive forces in the arc—one occurring at each contact of the carbons and the vapor column. The one nearer the positive electrode is the greater. This is the true counter-electromotive force, since it acts in opposition to the current. The smaller one is the negative electrode, and acts with the current.

The objection to this explanation is that it calls for a thermoelectric power of the junction which is twenty times as great as that between bismuth and selenium at the same temperature.

It is interesting, in this connection, to note the similarity of this conclusion to the explanation offered by the action of the Jacques cell. In this attempt to produce electrical energy by the direct combustion of carbon, a rod of carbon was immersed in molten sodium hydrate contained in an iron vessel. An electromotive force of 0.9 volt was developed. This was first supposed to be due to a direct reaction between the carbon rod and the air which was forced through the molten salt. Reed showed that this was not the case, and offered the suggestion that the action was thermoelectric. His position was apparently upheld by the fact that the oxygen could be replaced by a neutral gas without affecting the action. This, however, called for a thermoelectric force much greater than anything that had been known before. This explanation was

pretty generally accepted until last summer, when Dr. F. Haber, in a paper before the International Electrical Congress, showed that the electromotive force given by the Jacques cell is due to chemical action, but as a method of producing electrical energy, the cell is bad.

May it not be possible that there is some such action going on in the electric arc which sets up these electromotive forces? Not only is there chemical action going on in the arc, but there are violent physical changes taking place, either or both of which might be sufficient to account for these electromotive forces. The evidence, so far as presented, seems hardly sufficient to warrant the assumption of a thermoelectric action.

Mr. Duddell finds that the resistance of the arc may be considered as consisting of several components. There are the resistance of the vapor column and the resistances at the two points of contact between the vapor and the carbons. The first of these—that of the vapor column—depends upon the impurities present in the carbon, and decreases with an increase in these impurities. In addition to these three resistances, which cause a fall of potential, are the two electromotive forces at the contacts between the carbon electrodes and the vapor column, so that there are altogether five factors acting against or with the flow of current. These electromotive forces of contact increase with increasing impurity, so that while impregnated carbon gives off a vapor of high conductivity, and hence operates with a long arc, it also increases these contact electromotive forces, so that a gain in one part of the circuit is partially compensated for by the loss in the other. The contact resistance which is met by the current in passing from carbon to vapor, or vapor to carbon, is high, and it is these resistances, which in the case of the positive carbon act with the contact electromotive forces, and at the negative carbon are opposed by the action of the electromotive force, that cause the high temperature of the arc. It is interesting in connection with Mr. Duddell's results to refer to a paper by Mr. William S. Weedon, presented at the fifth general meeting of the American Electrochemical Society, which dealt with arcs drawn between metallic electrodes.

The existence of these contact electromotive forces of any arc suggests the possibility of utilizing this action to produce electrical energy directly from carbon. If, on the passage of current through the arc, an electromotive force is developed, it would seem that if the proper conditions are obtained, this electromotive force will be produced and will cause a current to flow. It is true that this reaction could not take place without the production of heat, but unless the electromotive force is a true thermoelectromotive force, the efficiency will not depend upon the second law of thermodynamics, and the production of a high temperature need not necessarily mean an inefficient process, since by proper insulation this temperature could be maintained without much radiation. Dr. Haber's paper showed pretty conclusively that the methods adopted by Jacques and others offer but little hope of success, so that it would seem worth while trying other plans. The problem here presented is somewhat similar to that undertaken by Faraday, who, knowing that an electric current would set up a magnetic field, undertook to reverse the process, and, given a magnetic field, sought to produce by means of it an electric current.

THE ADVANTAGES OF ELECTRIC COAL-CUTTING MACHINES.

In the second report of the British royal commission on coal supplies some valuable information respecting the use of coal-cutting machines is given by Mr. G. E. Stringer. This report discusses at some length the use of electricity and pneumatic coal-cutting machines in two of the Yorkshire collieries, comparing their performance with hand-working, and then comparing the electric and the pneumatic machines with one another.

Taking up first the comparison of machine and hand-working, the cost of getting the coal was less with the machine than by hand. The difference in cost per ton varied between five and one-half and fifteen cents, depending upon the kind of coal mined and the depth of the seam. These costs include every kind of labor, even to filling the tubs. Where the coal is harder and the seam thinner the difference in favor of machine-cutting is the greater, because work by hand there is more difficult. These figures, however, do not include interest on capital or cost of repairs.

Another advantage of machine-cutting is the greater percentage of large coal obtained. This varies from eleven to twenty-nine per cent, according to the quality of the coal.

Comparing hand and machine-working in another way, it is stated in the report that the cost of driving headings by means of a machine is from sixty cents to one dollar less per yard than for hand-driving, and, at the same time, the coal taken at headings by the machines has a higher percentage of large coal.

Comparing the pneumatic and electric machines, Mr. Stringer says that the latter is more efficient, since the losses in generating and transmitting electrical energy are less than those when transmitting air. It should be said, however, in this particular comparison, that the electrical machinery is newer and better than the air-compressors, but, whereas the latter machines required 5.76 pounds of coal burned in the station for every superficial foot of work, the electrical system required only 0.81 pound. This difference can not be due entirely to the superior quality of the electrical machinery, but must be credited, in part, to a better system. The conclusion is drawn that there will be a considerable saving in the use of electricity, as compared with compressed air, for coal-cutting, wherever the former can be introduced.

The advantages claimed for coal-cutting machines are: the greater safety for the men, less damage to overhanging seams, the working surfaces are more easily ventilated, and the workings are more easily superintended, while the attack is more regular. The chief difficulties experienced when coal-cutting machinery was introduced arose more from the men than from the machines, due principally to the fact that the system was entirely new to the men. The chief disadvantage is the cost of the installation, repairs and renewals. This is largely offset, however, by the decrease in the cost of working, increased output of the mine, and the ability to work economically seams too thin to be worked by hand.

Electricity in 1904.

A Review of the Substantial Progress Made in Electrical Science and Arts During the Past Year.

IN REVIEWING the progress in electrical matters which took place during the past year, there are several features which are impressive. For some years past certain branches of the electrical industry have been marked by an almost feverish activity in extension and construction. Some of this work, it is true, was greatly needed, yet, on the other hand, a certain amount was more or less speculative. In contrast with this the record for the past year stands out sharply, for the work which has been done—and there has been a great deal—is notable for its value as an investment. In all branches of the industry there has been substantial growth and development, which has been necessitated by the increasing demand for electrical apparatus and power. This increase in the use of electricity has been brought about by the demands of those who wish only a few incandescent lamps or a small motor, as well as by those who require large blocks of power, either for lighting important places or for operating large motors. In fact, one of the noteworthy features of the year has been the increasing demand for electric light and power for small places of business.

There were no startling discoveries in electrical science announced during the year, nor have there been any particularly remarkably new applications. In certain branches new types of machines have been put upon the market or applied in commercial service for the first time, but these machines, in nearly all cases, have been described before, the work of the past year being mainly that of testing and improving them. These developments, as well as the growth of the various branches of the electrical industry, are reviewed more at length in the signed contributions which follow. It is intended here to take a more general view of this progress, and to touch upon the advance of the electrical industry as a whole.

TELEGRAPHY.

By virtue of its seniority the electric telegraph demands first consideration. The Morse system still holds its own as the simplest and most satisfactory for all purposes, but much skill has been expended in improving the apparatus and in simplifying the carrying in and arrangement of the wires in important offices. Outside, the tendency is toward more substantial construction of overhead lines and toward underground wires in cities.

During the year announcements were made of two important telegraphic inventions. The first made public was the statement that Mr. Stephen D. Field has brought to a satisfactory state his telegraphic amplifier, which, while primarily intended for application to cable work—enabling such messages to be taken down by a Morse receiver—can also be used as a relay, receiving the cable message and relaying it to a land line, thus taking the place of the operator at that point. A description of this device was not given, but Mr. Field says that it is so delicate that it will respond also to wireless messages, and hence can be used as a wireless receiver or relay.

The second announcement was not made until December. It was to the effect that the printing-telegraph system upon which Mr. John C. Barclay, assistant general manager of the Western Union Telegraph Company, has been at work for the past five years, had been brought to a satisfactory point of development and was put into service on certain of the Western Union lines. This is a page-printing system, the operator merely spelling out his message, as it were, on a typewriter keyboard, the message being reproduced at the other end in page form. The speed is limited only by the skill of the operator. In fact, by means of a Wheatstone transmitter, and by the use of punched tapes, messages can be sent at the rate of 100 words per minute.

The business of the two large telegraph companies made a substantial increase during the year, but statistics for the twelve months ending December 31 are not available at this time. However, as an indication of what this increase will be, the annual report of Colonel Robert C. Clowry, the able executive of the Western Union Telegraph Company, for the year ending June 30, 1904, shows that during the preceding twelve months nearly 68,000,000 messages, not including those sent over leased lines, were transmitted over the 1,155,000 miles of wire operated by the company.

The Postal Telegraph-Cable Company during the year added substantially to its business and to its equipment. This company is now operating approximately 282,000 miles of wire, including the submarine cables operated by the Commercial Cable Company. The number of messages handled by this company during 1903 was 21,600,000. Figures for the last year have not been made public as yet. The growth of the company has been rapid and continuous, and not a little of this healthy development is due to the energetic management of the president, Mr. Clarence H. Mackay, and his associates, Vice-Presidents W. H. Baker and E. C. Bradley of the telegraph company, and Mr. G. G. Ward, general manager of the cable company.

In the field of wireless telegraphy much skill and energy have been expended in improving and perfecting the various systems. There was little of a sensational nature, as efforts have been expended rather toward developing a thoroughly reliable and practical system, for which there is a wide field of usefulness. The employment of this method for communicating with ships has gone on steadily, but transatlantic communication is not yet in sight. The confusion resulting from the adoption of different systems by the various departments of the government at Washington has been eliminated by placing all government wireless stations under the control of the navy, and steps are now being taken looking toward preventing interference and the disastrous conditions which might result from indiscriminate operation of stations along the coast. Considerable progress was made in sending wireless messages over land.

TELEPHONY.

The steady and rapid increase in the use of the telephone which has taken place during the past ten years has continued during the last year. Indeed, the rate of increase is itself increasing, and the most troublesome problem confronting the large telephone companies is to provide for the new subscribers. The Bell companies to-day have not far from 2,000,000 subscribers, while it is estimated that the independent companies have 2,500,000. The number of telephone messages transmitted by the Bell companies alone is probably approximately 8,000 per minute, and, assuming the same ratio, the number of independent messages per minute would be 10,000. This is a good illustration of the important position filled by the telephone. In construction work the tendency, as in telegraphy, is toward more substantial overhead lines, and toward underground lines in cities. The

manufacturers are giving much attention to improving the apparatus, with a view of facilitating quickness of service; and with the same purpose in view, the operating companies are doing much to improve the service by careful training of their employés.

The extension of the telephone, taking all things into consideration, is far greater in the United States than in any of the countries of Europe. Statistics covering the year 1903 show that Great Britain and Ireland at that time had in service only a little over 300,000 telephone stations. In Germany the number was somewhat greater, being almost 400,000; while in France it was considerably less, being but a little over 100,000 stations.

The expansion of the telephone service is not limited to city and suburban service, for an important part is now being played by it in country and even in frontier life. Lumber camps which were formerly isolated during the winter, except for an occasional messenger, are now kept in communication with the main office by means of the telephone. Our forest preserves are being protected against fire in a similar way, and, as has frequently been noted, the farmer finds the telephone service of inestimable value in ordering supplies and disposing of his stock. In city offices the telephone service is being carried to its logical end, for placing an instrument on every desk, with a local operator in the office. Thus each business house becomes practically a branch exchange.

ELECTRIC LIGHT AND POWER.

Of the other applications of electricity, electric lighting may be considered first. In this branch of the industry the past year showed a good increase, and it is in the use of electric lights and power that the smaller user figures most importantly. It is possible that this phase of the development may have resulted from the fact that the large users of electrical energy, both for lighting and for power, had already adopted this system, and the supply companies therefore devoted their efforts toward interesting the smaller consumer. However this may have come about, the fact remains that no shop can be considered modern today unless it is lighted electrically and even ventilated by electric fans.

The incandescent lamp has been standardized for many years, and as yet efforts to improve its efficiency by using special kinds of filament have not been altogether successful. The most noteworthy attempt of this kind was the bringing out of the osmium lamp. This lamp has been applied in Europe for use on fifty-volt circuits, but in this country it is as yet a curiosity. The use of the Nernst lamp is increasing for the lighting of large interiors, for which purpose it is so admirably adapted.

In arc lighting the most important event was the announcement of the successful development of the magnetite lamp, brought out by the General Electric Company. This is a long arc lamp, and gives a white light which is well distributed. It has a high economy, and is said to be unsurpassed for street lighting. A number of these lamps have been in operation for some time past, and it is stated that they have given entire satisfaction. The other types of flaming arc lamps, such as the Blondel, have shown a high efficiency in the laboratory, but have not been accepted in this country, though it is reported that several cities in Europe have adopted them.

The Cooper Hewitt mercury vapor lamp has been accepted as a standard illuminant for photographic purposes, and in this use it has given excellent service.

The important problem of improving the efficiency of electric lamps has not been neglected, but there has been no unusual development during the year in this direction.

The tendency in central station design shows the effects of the steam turbine. The practice now is to divide the generating equipment into a number of independent units, bringing them together only at the switchboard. Thus each of the turbines has its own boiler plant, its condensers, pumps, and drives its own generator. This type of design it is anticipated will add greatly to the reliability of the service and promote economy of operation.

ELECTRIC RAILWAYS.

In the electric railway field the record of the year shows that there has been less building and planning for new roads than usual. There has been rather a pause which is allowing the business of those companies already in operation to catch up with the transportation facilities offered. This is, on the whole, a good feature, for there has been a tendency to overwork the railway field.

During the year several important electric railway events took place. The first of these was the opening of the New York subway. This magnificent underground system, which has cost the city of New York $35,000,000, and which has been building for the past five years, was thrown open to the public in October, and it immediately settled down to its work. While there have been a few hitches in its operation, these have been of small consequence, and, taken as a whole, the ease with which the new road was put into service has been remarkable. It has brought to the city much-needed relief, but it is having a greater influence than had been anticipated in educating the city to its needs, and as a result of its first few months of operation there are now in contemplation plans for several new lines, and the removal of the elevated roads, and their replacement by subways, is being urged.

Another important event was the testing of the new electric locomotive for the New York Central & Hudson River Railroad Company. This locomotive, which has been constructed by the General Electric Company and the American Locomotive Company embodies certain departures in design from which much is expected. The test was pronounced a success in every way, and it is thought that this new machine will meet satisfactorily every requirement in handling heavy through trains operated over the electrical division of this road.

Many of the large railway systems are now studying the adoption of electric traction for their suburban lines. The Pennsylvania Railroad is at work on its New York terminal, which is to be reached by tunnels under the Hudson and East rivers, and it was announced during the year that the other large roads in the vicinity of New York would adopt electric traction on their suburban systems.

Much progress has been made in the building of an alternating-current railway motor. There are now a number of types offered, but the large companies of this country have decided in favor of the series type. In Europe the more complicated compensated types are much in favor. As yet there is no railway operated entirely by single-phase, alternating-current motors, though both the Westinghouse Electric and Manufacturing Company and the General Electric Company have had car equipments of this type in use for some time. The feeling seems to be that while this motor may give the service that is expected of it, there are few places to-day where the direct-current motor is not satisfactory, and there is as yet no need to scrap the old equipments in favor of something thus far untried.

POWER TRANSMISSION.

High-tension electrical transmission is passing out of the stage of pioneer work,

and is now becoming standardized. Sixty thousand volts seems to have been decided upon as a satisfactory working limit, and energy is being directed toward rendering this thoroughly reliable in service. There are a number of such systems now in operation on the Pacific coast.

In other sections of the country the water powers are being developed and utilized for operating factories and for city lighting. At Niagara Falls, where the largest work in this direction is going on, there are to-day two companies in operation on the American side, and three companies on the Canadian side at work on power-houses. The total output of these plants, when completed, will be in the neighborhood of 530,000 horse-power. At other points of Canada, particularly Montreal, important work in power transmission is also going on.

ELECTROCHEMISTRY AND ELECTROMETALLURGY.

In electrochemical and electrometallurgical circles the year has been a quiet one devoted, as in the other branches, to developing and improving existing methods. There have been no important announcements. Possibly the most significant incident of the year was the report of the Canadian committee appointed to investigate the electrical manufacture of iron and steel. This committee, after an extended tour in Europe, during which important tests were conducted, reported that, at the present time, it is entirely practicable to manufacture steel in the electric furnace, but the conditions are not favorable to the production of iron in the same way. The object of this investigation was to see whether it would be practicable to develop the valuable ore deposits of Canada, utilizing for this purpose her numerous water powers.

STORAGE BATTERIES.

The developments of the year in storage battery construction and utilization have brought forth nothing of unusual interest. An accumulator auxiliary is now recognized as an essential part of the equipment of every important generating station. The use of storage batteries for automobile service is limited almost entirely to heavy trucking in cities, in which service the advantages of the electric motor count most, and where the limited range of action is of little importance.

ELECTRICAL SCIENCE.

The energies of those upon whom we are dependent for our scientific advance have been directed along many lines, but that which has attracted the most attention has been in exploring the fields of radioactivity and atomic physics and in elaborating the new hypotheses suggested the year before.

There were two events of importance to all branches of electrical arts and science. These were the International Electrical Congress, held at St. Louis, Mo., in September, and the electrical exhibit at the Louisiana Purchase Exposition. At the first of these a large number of valuable papers were presented, the effect of which, however, could not be felt during that year. On the other hand, it is probable that the unsurpassed exhibit of electrical machinery and systems, brought together at the exposition through the efforts of Director W. E. Goldsborough, will have more immediate results. Never before has such a large and varied exhibit of electrical appliances been assembled. This section was certainly one of the most important of the entire fair, and, in fact, it is not too much to say that, taking everything into consideration, the most influential factor in the success of the fair was electricity.

It will be seen that, as a whole, the year brought substantial progress along many lines, and there is much cause for satisfaction for the character of the progress.

From present indications it is thought that the activity of the year just opening will be greater than that of the one just closed, and should this prove to be the case the conservative development of 1904 will be an important factor in the new work.

The Electrification of Trunk Lines.

By W. Caryl Ely, President American Street Railway Association.

DEVELOPMENTS in the electric railway field during the past year have been very marked.

The New York Central & Hudson River Railroad Company has completed plans for the electrification, within the thirty-five-mile limit, of its trunk lines entering New York city; the Pennsylvania Railroad Company has determined to electrify its New York city terminals; the subway of the Interborough Rapid Transit Company has been successfully opened for traffic; several of the leading steam roads have purchased electric street and interurban systems for operation in connection with their existing lines, thus marking the demolition of the old lines of antagonism between the two systems of propulsion; the single-phase alternating-current motor has been perfected and put into successful operation and there has been completed and successfully tested an electric locomotive of sufficient size, speed and power to meet the requirements of trunk line railroad passenger service—a tremendous spurt of activity, after a considerable period of seeming lethargy.

It is difficult to anticipate what may take place during the coming year, but it would seem to be safe to say that the time is not far distant when electrical power generated from the waters of the Hudson, the St. Lawrence and the Niagara will be freely used in the operation of cars and the furnishing of light in the city of New York. And further, that the interval to elapse before main trunk lines of railroads, in New York state at least, may be successfully operated by electricity has been, and will be, materially shortened.

The Growth of Philadelphia Rapid Transit.

In 1898 the Philadelphia Union Traction Company had in operation 448 miles of track. The Philadelphia Rapid Transit Company, which now leases the Union Traction Company, operates 545 miles of track. In 1902 the rapid transit company had a surplus over all charges of $405,888, and in 1903—the second year of its operation—the surplus was $220,849. In 1890 the net earnings of the system were $2,465,194, against $8,103,048 in 1904. The ratio of operating expenses to gross earnings in 1890 was sixty-three per cent, and in 1894 it was forty-nine per cent. The growth of the system's business is measured by the number of passengers carried. In 1890 there were 143,885,816. In 1902 there were 325,801,963, and in 1904 there were 390,532,689.

Electrical Transmission of Power.

THE past year has done much toward crystallizing practice in the electrical transmission of power. Until recently 40,000 volts was considered the safe limit, but there are to-day several plants operating at practically 60,000 volts. Transmission engineers seem to have decided that at the present time this is a satisfactory limit, and they are, therefore, devoting their attention toward improving construction. A feature of this is the more substantial method of erecting lines, and many are now in favor of steel towers in place of the old wooden poles. The difficulty of securing a satisfactory insulator, which until recently limited the operating potential, seems now to be overcome—at least for 60,000 volts. The insulators are now made in sections, vitrified independently and assembled on the ground.

The greatest development in long-distance transmission at the present time is taking place on the Pacific coast, where coal is expensive. The California Gas and Electric Corporation, the largest company in that section, has now in continuous operation 700 miles of high-voltage lines. By this is meant lines on which the voltage is 40,000 or over. This company is transmitting power regularly a distance of 200 miles, and on one occasion, for a week or more, power was transmitted about 300 miles, the necessity being due to the temporary disablement of one of the stations. This company is distributing in the neighborhood of 45,000 kilowatts.

Another important centre is at Niagara Falls, though here the conditions existing are somewhat different. The distances to be covered are not so great—at least, the district which is at present served and that in contemplation will not be as far from the power stations as is true in California. This, of course, is due to the establishment of large manufacturing companies near the power-houses, which absorb practically all the output of the American stations. The stations on the Canadian side are not yet in operation, though the Canadian Niagara Power Company tested two of its large 10,000-horse-power generating sets the first of the present year. The generating stations now in operation and those being constructed will, when completed, have an aggregate output of 530,000 horse-power.

Much engineering ability has been directed toward improving and simplifying the methods of carrying and controlling high-tension circuits within buildings. A practice much in favor is that of isolating, as far as possible, the separate appliances by means of fireproof partitions, and of grouping different devices on the different floors of a switch-house. It is recognized that as each device or instrument is in itself a source of weakness, the fewer of these installed the better for the reliability of the station.

In Europe the practice in long-distance transmission is naturally somewhat in the rear of that of this country, but one system, put into service some months ago in Italy, is now operating at 40,000 volts. In England the highest voltage at the present time is about 10,000, though voltages of about 30,000 or 40,000 are planned for on systems now in course of development. One feature of the English work in this line is the supplying of large districts, such as South Wales, from two or three advantageously located generating stations. This power is used not only for lighting towns and for operating railways, but for driving the mills and for doing the work in the mines. These stations are in general operated by steam. The water power used in England for generating electricity is not more than 10,000 horse-power.

In other countries there is a healthy growth of long-distance transmission. In France, Switzerland and Italy there is a good deal of activity in developing the many waterfalls and transmitting the power thus obtained to towns and manufacturing centres. India is, as well, carrying out important work in hydro-electric developments and transmission, and Canada is following close on the footsteps of this country. It is estimated that the total development of water powers throughout the world used in producing electrical energy is between 1,500,000 and 2,000,000 horse-power, all of which has taken place during the past fifteen years or so.

The experience of the year has shown that it is practical to transmit large amounts of power very great distances by means of high voltages, but as yet conditions do not seem to warrant any unusual attempts in this direction. There are few, if any, large water powers which could not dispose of their entire output within a radius of 100 miles, and 60,000 volts is high enough for transmitting this distance. On the other hand, there is the problem of supplying the needs of large industrial centres situated more than 100 miles away from an important water power. Whether this will be met by high-voltage transmission or by local generating stations can not be foreseen, but except under unusual conditions the advantage will probably rest with the local station for some time at least.

Electric Lighting in New England.

By C. L. Edgar.

The principal development in electric lighting matters in New England during the past year has been the completion of the Boston Edison Company's large turbine station. This is notable in two ways. First, in the installation of very large, four-stage turbines, with condensers in the base, being the first installation of its kind. This station was started so late in the year that up to the present time no exact data whatever have been obtained as to the economy, except the very general one that the station operating only one shift is somewhat more economical than the old station operating three shifts. By the end of this year we ought to have some very valuable data regarding this installation.

The second thing to note in connection with this completion is the long-distance transmission, running from this station into the surrounding towns. To those engaged in electrical work in the West, our use of the words "long distance" would be considered somewhat ridiculous. Having in mind the one hundred and two hundred-mile distances to which electricity is transmitted in the western states, our little transmission of thirty miles seems very insignificant. It has, however, been quite a problem here, owing to the settled territory through which the lines have had to run, and we have had innumerable obstacles to overcome in getting 7,000-volt transmission lines distributed over a territory twenty-five miles square. Our difficulties, of course, have not been electrical but structural.

As far as I can see, the year 1905 is going to be very largely a routine one. We will, during the year, perfect our organization and get more fully than before the benefits of the shutting down of twenty suburban stations and the starting up of one large water-side station to take their places.

Recent Improvements in Telegraphy.

By J. C. Barclay.

WITH one or two exceptions, to be hereinafter noted, the improvements effected in telegraphy during the past year have not been of a character that would individually call for more than passing notice, but taken in the aggregate, they represent an advance in this particular field of industry that has had, and will continue to have, a most important bearing upon telegraph interests generally.

It is well understood by those "versed in the art" that improvements, as a rule, are brought about not so much by the brilliant discoveries made, as by that close attention to little matters of detail in every branch of the service without which the art of telegraphy could never have attained its present high standard of efficiency.

In the matter of line construction, for instance, the number of poles per mile has been considerably increased, large and substantial structures having been recently erected by the Western Union Telegraph Company and guyed at certain intervals by a series of stranded galvanized wires capable of withstanding a breaking strain of 10,000 pounds, which have solidified its pole lines to such an extent that storms, which but a short time ago would have laid them low, have now practically little effect upon them. When this system of construction shall have been extended to all the principal telegraph points, it is hoped and believed that nothing short of a cyclone or other untoward event will destroy the communication between such points.

The use of hard-drawn copper of great conductivity and durability in place of the more highly resisting and perishable iron wire formerly employed has been enormously increased and is being rapidly extended in all directions.

Dynamo machines and storage batteries in great numbers continue to replace the inefficient and space-occupying chemical batteries.

The immense volume of business now handled by the various telegraph organizations could only be successfully accomplished by the use of machinery and appliances of the most varied and up-to-date character, hence, every office is now equipped with apparatus representing all the latest improved methods of telegraphic transmission and reception.

The changes made in the ocean cable equipment consist principally in the substitution of automatic transmission for the ordinary method of hand-signaling previously in vogue. The precise and uniform character of the currents transmitted by these automatic machines not only makes the work of transcription less difficult, but enables the cables to be operated at a higher rate of speed. An innovation of considerable practical importance has been recently made in connection with this particular branch of the Western Union service by the employment of an exceedingly simple and efficient electrical perforating machine which admits of the slip being "punched" with a degree of ease not heretofore attained, and at a rate of speed greatly in excess of that possible with the ordinary style of punching apparatus. The cable interests have been closely considered in various other ways, but mainly in the direction of reducing the K.R. value of the conductors, and in trying new systems, of which one at least bids fair to attain considerable increase in the speed of signaling, with the additional advantage of being able to utilize the ordinary Morse in place of the present recording apparatus.

Direct communication between the most distant points on land lines is one of the highly important practical results of the use of a repeating relay which the writer had the honor of first introducing upon the Western Union lines some two years ago. It is a device that admits of the direct reception and transmission of currents from one line to another, differing in this respect from the ordinary repeater arrangement, which can only affect the necessary work through the interposition at each repeating station of certain local apparatus having a penchant for "getting out of order," and whose instability of working seriously limited the range of long-distance transmission. It is now possible to work direct over practically unlimited distances at increased speed, the received signals being much more clear than any heretofore obtained under such conditions, and circuits from New York to San Francisco, Cal., Cuba, Galveston, Tex., Heart's Content, N. F., and a host of other places far and near are already equipped with the new repeating device.

Perhaps the greatest achievement in the way of telegraphic development, and one calculated to bring about radical changes in existing methods of working, is that connected with the printing-telegraph art, which for years past has been struggling hard to find favor with the telegraphing public, and to firmly establish itself among the various systems employed in ordinary commercial telegraphy.

A great number of printing-telegraph systems have been tried and found wanting. Two or three have gained a foothold by proving more or less successful in experimental work or under actual working conditions, but all have grave defects that seriously impair their usefulness, and under such circumstances nothing in the way of a rapid extension of such systems could be looked for. A system involving essentially the use of a typewriter for transmitting, and another for receiving the messages, was found to be highly desirable, not only because such an arrangement would practically double the carrying capacity of wires over which the system was operated, but the use of high-skilled labor and complicated machinery could be more or less dispensed with, incidental advantages being gained in the way of securing a perfect record of all desirable characters, and in less time withal than that possible through the medium of any system in which a perforated tape forms part of the transmitting arrangement.

Such a system as that above outlined has been developed by the author and is now in practical operation over the Western Union lines between New York and Buffalo, with results so entirely satisfactory that as soon as the necessary arrangements can be made circuits in various other directions will be equipped with the new printing mechanism.

The above rough sketch, which but lightly touches upon a few of the more important features of telegraphic development so far as the Western Union is concerned, will very inadequately convey an idea of the vast number of changes—both great and small—which are constantly taking place to the betterment of the telegraph service, the enormous interests of which may be indicated by the statement that the above-mentioned company alone embraces in its system no less than 1,089,212 miles of wire, with 196,517 miles of poles and cables, over which nearly 80,000,000 messages—not including those sent over leased wires and under railroad contract—were transmitted during the year 1903.

The progress made in telegraphy during the past year has, to say the least, been quite considerable, and in every way calculated to increase the efficiency of an art, the needs and necessities of which are thoroughly understood and appreciated by those whose aim and object must ever be to keep pace with the times, and thus fully meet all the demands and requirements of a modern telegraph service.

The Electric Railway Situation.

By Dr. Louis Bell.

THE year just passed has seen few sensational developments in any of the electrical arts, and electric railroading has been no exception to the rule. Activity has been mainly in interurban lines of which there has been much building, none of it of a specially striking character. There has been, too, quite a bit of consolidation of various interurban properties and some extension of power transmission to large railway systems from consolidated central stations. In the writer's judgment there is more danger of overdoing than underdoing this particular feat of engineering.

The greatest novelty of the year has been the steady heralding of a new era in which alternating-current series motors shall reign magnificent. The preliminary tuning up and the premonitory blasts came last year. All this year we who wait have been hearing the fanfare echoing among the distant hills, but the head of the procession is not yet in sight. It has been announced repeatedly, but seems to be still marking time somewhere in the about-to-be. To those who, like the writer, have been eagerly awaiting an alternating traction system, the delay is a keen disappointment. The conviction is growing in the engineering profession that Dr. Finzi's announcement forced the hands of the American manufacturers to a very embarrassing degree, and that while from a purely engineering standpoint some very admirable results have been reached, a policy has been inaugurated of side-stepping the issue whenever possible. There is little use speculating on the cause of this attitude, which may result from some trivial "bugs" which still have to be exterminated, from sharp differences of opinion in the engineering staff or merely from the desire to avoid the undeniable difficulties of badly mixed production. The fact, however, remains that while alternating railway motors are apparently all ready for the market and are cordially recommended in cases suited to their use, such cases seem suddenly to have become most extraordinarily scarce. Why we shall soon know, for the situation is too absurd to persist for any considerable length of time.

The most important enterprise inaugurated during the year is the New York subway, of which one can hardly speak too enthusiastically. It has been a splendid feat of engineering and has resulted in a brilliant operative success. It is one of the rare cases in which a great work seems to have been carried out with adequate thoroughness. The Subway will relieve the rapid transit situation in the metropolis for some time to come, although if the present rate of growth is kept up there will be need for auxiliary work perhaps sooner than one thinks, to open new fields, however, rather than to give added facilities along present lines. The gain in speed of transit has been all that was hoped for, and is certain to produce a very material redistribution of population until, at least, tunnels under the rivers are completed.

A potent factor in the same problem of population is likely to be the electrical equipment of the New York Central's terminal and suburban system now near at hand. The locomotive for this work recently tested is, by the way, one of the most interesting electrical machines yet devised. The escape from the usual dilemma between gearing and the difficulties of direct driving was very cleverly contrived. By making the truck frame part of the magnetic circuit and getting the necessary mechanical play in the pole-gaps, the weight carried dead upon the axles is actually brought below that necessary in a steam locomotive of equal power, with the advantage of the abolition of hammering due to reciprocating parts. With the fast suburban service now possible the subway and the New York Central should be able to push the metropolis far up the Hudson in an almost continuous stretch.

The effects of this innovation will be closely watched by railroad men, for while there are many cases in which electric suburban work would be desirable, all eyes have been turned on New York, where the main issue was forced, and all hands are waiting for the results. The introduction of electric suburban service is a thing which may be so far-reaching in its consequences that railway men generally have been disposed to hold back and probably will still do so until compelled to move. Pressure will soon be applied by the growth of interurban systems as competing lines. Until very recently interurban systems have been run with very little regard for through traffic, much as railway lines were run half a century ago. There are now signs that consolidation will bring with it some appreciation of an interurban network as a whole. Steps have recently been taken on one of the largest of this class to push the through business by improving connections, selling through tickets and other obvious means. The more this sort of thing is done the sooner will the steam roads take off their peanut trains and put in a business-like suburban system. There is a tremendous future in the interurban business, but until the managers appreciate the importance of through cars, through schedules and through tickets, that future will be dwarfed.

In one thing, however, the spirit of progress is very conspicuous, and that is in the improvement of rolling stock. A very large number of fine cars have been put into service this year all over the country, big fellows with cross-seats, and every improvement in construction to give convenience and easy riding. This is the first step toward the through service just mentioned, and a most important one.

It is unfortunate that equal improvement has not been made in safety appliances. Although the electric railway record for the year has been far less sanguinary than the general railroad record, it is still bad enough. There has been a long list of more or less serious accidents, mostly chargeable to the same fundamental cause—an attempt to run heavy cars at high speed on a single track without any, or adequate, safety devices. Operating a single-track road is no easy matter, even under the most favorable conditions, and with a comparatively small number of trains. When one tries to increase the number of trains, retaining nearly the same speed, the difficulties are very greatly enhanced. The state of things is getting serious and it is up to the interurban lines to work out an adequate system of safeguards unless they wish to foster public opposition to their further extension.

In apparatus and methods, generally speaking, changes have been small. In railway power stations there has been increasing use of steam turbines wherever the output has been alternating current. The ease with which these machines put up an excellent performance at varying load-factor is a strong point in their favor. If they were equally well fitted for direct coupling to direct-current generators their usefulness for railway purposes would be

greatly increased, since they would then be convenient for the small systems in which the load-factor is particularly bad. Some recent tests abroad of a 500-kilowatt turbine set (of American make, it is pleasant to note) gave decidedly encouraging results. In very large stations in which the load-factor can be kept high, turbines must depend mainly upon their other advantages.

In this connection one should note the radical innovation about to be made in San Francisco, where the California Gas and Electric Corporation has just ordered three 4,000-kilowatt, three-phase generating sets, each driven by a 6,000-horse-power gas engine. These are stated to be for operating the street railways of the city. All sorts of reports are current about the performance of the big gas engines now used in this country, the majority of them rather unfavorable, but the engineers of this large corporation seem to have been convinced that the gas engine is all right. It has been looming large in the background for some time and its appearance at the front of the stage will be watched with the greatest interest. The writer is not prophet enough to proclaim the result, but our friends on the coast have a cheerful way of going ahead and doing the impossible that makes one very cautious of adverse predictions. If they succeed in this instance the battle of the engines long impending will be on in deadly earnest. Taking a broad view of the situation it looks as though the coming year might be decidedly interesting. Things have been very slow in getting ready to happen in electric traction, but there surely are signs that something will soon be doing.

Progress in the Electrochemical and Electrometallurgical Industries in 1904.

By John B. C. Kershaw.

ALTHOUGH no striking discovery or invention in the development of the electrochemical and electrometallurgical industries has marked the year 1904, considerable progress has been made in the case of new industries, especially in connection with the electrical processes of iron and steel production, and with the methods for fixing the nitrogen of the air either in combination with oxygen or with carbon. The importance of these methods for drawing upon the almost limitless supplies of nitrogen in the atmosphere, in view of the decreasing reserves of naturally occurring nitrates in the earth's crust, has been emphasized already more than once in the columns of the ELECTRICAL REVIEW; and there is little doubt that in time the supply of combined nitrogen required for support of the world's cereal crop will be drawn from this source.

Some details of these processes, and of the position in the older industries, are given under the respective headings in the following review:

ALKALI AND BLEACH.

The electrolytic alkali and bleach industry is advancing in America, but is practically stationary in Europe, owing to excessive production of chlorine products, and to the low prices which can be obtained for these in the open market. During 1904 the position in England and Germany has been slightly improved by the renewal of the agreement as regards production and sale of bleach between the Le Blanc and electrolytic manufacturers, but the price of this chemical has not yet advanced to its former level, and it remains at about twenty-one dollars per ton, f. o. b., Liverpool.

In France and Italy the managers of the electrolytic alkali works are seeking to use their chlorine in other manufactures; and carbon tetrachloride and pure hydrochloric acid are being produced in these works. Attention is also being given to the great waste of hydrogen gas which at present occurs in all electrolytic alkali works, one ton of this gas being liberated at the cathode for every thirty-five tons of chlorine produced; and in some of the German works the hydrogen is being collected, purified, dried and compressed in steel cylinders for sale to various users. Electrolytic chlorine is also being used extensively in some of the German color and pharmaceutical chemical factories for producing the intermediate chlorination products and changes in these manufactures. The electrolytic alkali industry in America is more progressive.

ALUMINUM.

The aluminum industry is slowly advancing both in America and in Europe; but as none of the companies engaged in the industry is now willing to publish figures for their annual production, this statement can not receive statistical support.

The Massena plant of the Pittsburg Reduction Company has been in operation during 1904, and should have materially augmented the American production—the total power available in the three plants of this company being now raised to 22,000 horse-power. In Europe, both the Neuhausen Aluminum Company and the British Aluminum Company have been increasing their power plants in Germany, Austria and Scotland, respectively. The first-named company has now 24,000 horse-power available for electrometallurgical purposes in its four works, but other manufactures than aluminum are carried on, the Heroult steel process being the last to be taken up.

An Italian company for carrying on the manufacture of aluminum from native bauxite has been promoted in Rome. The works are to be situated in the valley of Pescara, but they are not yet erected.

As regards utilization, Dr. Goldschmidt's "thermit" process for production of high temperatures in metallurgical and fusion operations has received the most notice during 1904; and the consumption of aluminum powder for manufacture of "thermit" must be increasing rapidly.

The use of aluminum wire for electrical transmission lines continues to extend in America, but makes little headway in Europe; expert opinion in England and Germany, based on actual trial, being that for such purpose aluminum is not sufficiently resistant to weather influences The electrodeposition of aluminum has attracted much attention during 1904. McDermott has stated that he can obtain dull deposits, which can be brightened by burnishing, from a basic sulphate solution; while Patten has obtained bright deposits from an ethyl bromide solution. Two Sheffield artisans have also discovered a solution and method by which silver can be satisfactorily plated on to aluminum. This process is considered to be of value since it will enable aluminum

(a cheaper metal than German silver) to be used as the base metal of all plated goods. Hambuechen and Burgess have also published details of a valuable research on this subject.

CALCIUM CARBIDE AND ACETYLENE.

The writer has no new facts or figures to report concerning these two industries in America. As regards Europe, although the calcium carbide and acetylene industries have not yet recovered from the unwise company promotion and speculation which occurred in the years 1899-1900, a large number of new works have been planned and in some cases brought into operation during 1904. Possibly these may prove remunerative where the position has been wisely chosen, and a market exists for this product in the immediate vicinity of the works. The works at Kerka, Dalmatia, promoted by an Italian company, and at Hafslund in Norway, promoted by a Swiss company, with Schuckert & Cie. behind it, are the most important of these new ventures.

As regards use, the central installations of acetylene gas as a lighting agent are increasing in number both in the United Kingdom and on the continent of Europe; and these installations when erected and worked under "expert" control appear to give complete satisfaction. A novel use of calcium carbide is in the manufacture of arc-lamp carbons, which when made from a mixture containing fifty per cent carbon and fifty per cent calcium carbide are said to emit a much more brilliant light. A French patent has been granted to Jay & Company, of Paris, for the production of alcohol from acetylene, but it is doubtful if this will be worked upon an industrial scale. The use of acetylene in blow-pipe work (in conjunction with oxygen) for metallurgical operations involving a very high temperature is believed to have a future, if the difficulties regarding storage and transport of this gas can be overcome.

CHLORATES AND HYPOCHLORITES.

There is nothing new to report concerning the electrolytic chlorate industry, which, like the electrolytic bleach industry, is suffering from the low prices ruling in the open market for its chief products. With regard to hypochlorites, some progress is believed to have occurred during 1904—and in America especially a large number of electrolytic plants are in operation producing hypochlorites of lime solutions for bleaching purposes, the caustic alkali produced at the cathode in such plants being run to waste. Kellner has just introduced a similar process in Europe for obtaining an oxidizing solution for the treatment of wood-pulp. The use of electrolyzed sea-water for sterilizing sewage is also again receiving attention, notwithstanding the failure of the Hermite process and cell ten years ago; and an installation of this type is being operated in America. Two companies are exploiting hypochlorite cells in England, namely, the Electrical Bleaching Company and Oxychlorides, Limited; the first having control of the Vogelsang patents, and the second of the Atkins patents. In Germany a large number of similar cells are patented, and are securing industrial trial, the chief of these being the Schuckert cell and the Haas and Oettel cell.

IRON AND STEEL.

The most striking progress of the year 1904 in the electrochemical and electrometallurgical industries has occurred in connection with the development of electrical methods of steel production. The earlier attempts to apply electrical heating to the reduction of iron ores have mostly given way to the more rational application of electricity to the manufacture of special alloys of iron and of steel from pig and scrap iron; and in this direction considerable success has been attained. A large number of patented processes and furnaces for carrying out this conversion of scrap iron into special varieties of steel are now being exploited in Europe and America, and there seems little doubt that this innovation in the steel industry will be permanent and will have an important future before it.

Limits of space will not permit of any detailed description in this brief summary of progress in 1904 of the different types of furnace and process now being used for this purpose in Europe and America. It must suffice here to state that furnaces with both arc and resistance heating are in use, and that France is leading in this new development of electrometallurgical industry. A scientific commission of investigation has been, during 1904, in that country on behalf of the Canadian government, and the report of this commission (recently published) recommends the introduction of the new methods of steel production into Canada. It seems highly probable, as the writer has before indicated, that in time the blast furnace will produce both pig iron and the necessary electrical power (by means of the waste gases and gas engines) for converting this pig into high-class steel; the pig iron being run direct from the blast furnace into the electrically heated refining furnaces, without any preliminary cooling and loss of heat. It is yet too early to say which steel-producing country will be the first to adopt this improved method of production, but it is reported that a German company has already such a plant designed and in course of erection.

NITRIC ACID FROM THE AIR.

The fixation of atmospheric nitrogen by spark discharges through air, and by formation of cyanogen compounds in the electric furnace, has continued to be the subject of a large number of laboratory and large scale investigations during 1904, and more than one of these processes may develop into a commercial success of some magnitude. The most extended trials with the method of spark discharge are occurring at Niagara Falls, where the Bradley & Lovejoy process is being operated by the Atmospheric Products Company; but Muthmann & Hopfer and Kowalski, in Germany, von Lepel, in Austria, and Birkland & Cyde, in Sweden, are experimenting with similar processes for nitric acid or nitrite production.

As regards cyanides, the Ampere Electrochemical Company, of Portchester, N. Y., claims to have solved the problem of the continuous production in the electric furnace, barium carbide being first formed; while Siemens & Halske, in Germany, have patented and are operating a process for producing calcium cyanamide in the electric furnace, from which compound potassium cyanide can be obtained by double decomposition. All of these processes can produce the desired chemical with more or less efficiency; the only question to be solved being that of their economic value and profit-earning capacity, in competition with the cyanides, ammonium sulphate, and nitrate of soda obtained from the more usual sources of supply. It would seem probable that until the natural deposits of nitrate of soda are exhausted, there will be little chance for the electric method to produce nitrates at a profit.

Limits of space will not allow of any detailed treatment of the electrochemical methods of producing ozone, oxygen and hydrogen, nickel, tin and zinc, or with the electric furnace processes for obtaining ferrosilicon, ferromanganese, ferrochromium, etc., and the similar processes for extracting copper, nickel and zinc from their ores. In all of these industries some progress has occurred during 1904.

Progress in Electric Lighting.

By J. H. Hallberg.

THE electric lighting industry of the United States has enjoyed marked advance and prosperity during the past year and several branches of the art have been subject to important developments—the close cooperation of manufacturers, engineers and central station managers, through the National Electric Light Association, being largely responsible for this rapid progress. The efficient generation and distribution of electric power and the establishment of proper and uniform rates have enabled the central stations to reduce their cost of production and the consumers have consequently benefited by a lower rate and a more prompt and reliable service.

INCANDESCENT LIGHTING.

The manufacturers of electric lighting appliances have introduced many new specialties, and the development of artistic candelabra, portable lamps and other fixtures for decorative purposes, which can now be bought at very reasonable prices, have materially increased the demand for incandescent lamps. The rapid introduction of electric signs and other advertising devices which require incandescent lamps has also increased the demand, and it has been observed that incandescent lamps, fitted with modern reflectors, have in many instances replaced the enclosed arc lamp, operated by isolated plants. The better distribution of light possible with the incandescent lamps, notwithstanding their lower efficiency, may, to a certain extent, account for this, but it is more probable that the general re-results from arc lamps operated by some isolated plants have not been satisfactory because of troubles experienced with the arc lamps, some of which may be of poor design and others not receiving proper care.

The incandescent lamp has also prominently entered the street lighting field, inasmuch as it is admirably adapted to operate in series with constant-current inductive regulators from constant-potential high-voltage alternating-current systems. The close regulation possible with inductive regulators permits the use of high-efficiency incandescent lamps, and central station managers are now wide-awake to this fact, and municipalities are realizing the advantages of small electric light units for certain classes of street lighting.

MERCURY VAPOR LAMPS.

This type of lamp has been installed in large numbers for photographic and similar purposes, to which it is particularly adapted. The color of the light from this type of lamp is, however, not suitable for general illumination, excepting in very few cases. The Hewitt mercury vapor lamp has been widely adopted for photoengraving purposes, being placed on the market in a number of practical forms. This type of lamp has also been recently installed for the illumination of large enclosed areas.

The vacuum tube lighting system invented by D. McFarlan Moore has now been installed in several places, and the practical results of this type of lamp will be followed with interest during the coming year.

THE NERNST LAMP.

During the past year a large number of Nernst lamps have been installed by many central stations and by several isolated plants, where there has been a demand for a lamp that would take the place of a very small arc lamp or a large incandescent lamp.

The Nernst lamp gives a beautiful steady light, and, on account of its high degree of perfection, it is now considered a very satisfactory and profitable lamp to the central stations.

It is to be hoped that the demand for this type of lamp will increase during the coming year, permitting it to be made in large quantities, so that it can be sold at a lower price than at present. This would undoubtedly be the means of a general adoption of this lamp on alternating-current systems. Several large manufacturing establishments have installed alternating-current generators and motors for driving the machinery in their plants, and they have found the Nernst lamp very useful and satisfactory.

As a general rule, street-lighting systems are now operated by alternating-current generators, and a comparatively small number of Nernst lamps are in use for street lighting, on account of the fact that they have to operate in multiple. It is to be hoped that some form of Nernst lamp may be developed which will operate satisfactorily in series on alternating current in connection with inductive regulators or constant-current transformers.

ARC LIGHTING.

The most important development in arc lighting during the past year is the perfection and practical application of the magnetite arc lamps for street lighting. As this lamp has a comparatively long flaming white arc it distributes a powerful light in a horizontal direction, which makes this lamp particularly suited to street lighting.

The efficiency of the lamp is also comparatively high, inasmuch as it is claimed by its manufacturers that 300 watts at the terminals will produce as much light as the ordinary arc lamp at 450 watts. The magnetite arc lamps operate in series on direct constant-current generators, which are preferably wound for about four amperes, and each lamp requires about eighty volts. Whether or not the higher efficiency and better quality of light from this type of lamp will offset the use of the constant-current series arc generator, as compared with inductive regulators or constant-current transformers for series alternating arc lighting remains to be seen. The central stations that have tried this system speak favorably of it, and if the arc is not subjected to side draughts, due generally to cracked or broken outer globes, the system operates very nicely.

There have been practically no new developments in the regular line of arc lamps for street and commercial purposes, although many important improvements in the details of the various lamps and systems have been made which contribute to increased economy and more reliable service.

One of the most important improvements which makes the closed base inner globe safer for series and high-voltage arc lamps is the development of a new trim, in which the arm which supports the lower carbon inside the inner globe is insulated from the upper globe support and the lower carbon-holder. The supporting arm is hollow, and the conductor which supplies current to the lower carbon-holder passes through this arm, but is insulated from it by small glass beads. Central station managers who have had much trouble with the arc jumping from the upper carbon to the frame which supports the lower carbon, thus destroying the entire upper globe support and the gas valve, will find that this new form

of construction will altogether prevent this kind of trouble, and the maintenance expense of arc lamps fitted with the closed-base inner globe will be materially reduced.

Some manufacturers are now building arc lamps which are practically non-destructible, inasmuch as the magnet windings are insulated with non-combustible material, which is of particular advantage on constant-potential arc lamps which use a regulating resistance inside of the case where the temperature is comparatively high. The insulating material in other parts of all modern arc lamps is also non-combustible, which materially increases the lasting qualities and improves the service of the lamps.

"The high economy" direct-current enclosed arc lamp, which operates with a ninety-seven-volt arc on a 110-volt circuit, has been improved to a considerable extent, and the inductive regulating coil which had to be placed several feet above the lamp in order to eliminate the fluctuations of the arc when this lamp was first brought out, has now been successfully placed directly above the operating mechanism in the lamp. This change, and the increase of current for the lamp from four amperes to five amperes, has made this lamp self-contained. The illumination is very satisfactory, notwithstanding the long arc, and the illuminating efficiency over the standard eighty-volt constant-potential enclosed arc lamp is claimed to be from thirty to forty per cent.

For street lighting, the constant-current series alternating enclosed arc lighting system has been in steady demand, and installations of lamps varying in current consumption from four to seven and one-half amperes, with seventy-two volts at the arc, have been made.

The four-ampere enclosed alternating-current arc lamp is probably too small a unit for general application, although the city of Cincinnati, Ohio, selected this size of lamp and installed 4,500 of them about two years ago, and last year the city government of Cincinnati ordered an additional lot of 1,200 four-ampere series alternating-current arc lamps installed for street lighting.

There is a remarkable difference in the illuminating power of a four and a five-ampere alternating-current arc lamp, and there is considerably less difference in illuminating power between a five-ampere and a 6.6-ampere alternating-current arc lamp, and a central station manager who controls a large number of plants has appreciated this fact, equipping all of his stations with 5 to 5.5-ampere series alternating-current arc lamps for street lighting, with excellent results.

Electrical Theories.

By Dr. John Trowbridge.

IT IS interesting to compare our present views in regard to the nature of electricity with the views held in the time of Franklin. Without going into much detail we can say that the fluid theories are generalizations of an apparent excess and deficit of electricity with resulting changes of pressure which have a close analogy to phenomena in the motion of fluids. Since the time of the founders of the fluid theories of electricity the mathematicians have built up a remarkable branch of mathematical physics called hydrodynamics, and the equations of motion which they have developed are at the foundation of the mathematical theory of electricity; indeed, it is the conviction of the most learned scholars in electricity that without a knowledge of hydrodynamics the student can not have clear views of electrical phenomena. The equations in hydrodynamics are very general and do not relate to any supposable particle in the fluids. They are in no sense equations of the dynamics of a particle.

It may be said that the mathematical physicist who formulates general equations of the motion of a fluid is in the condition of an observer in a balloon who studies a stream winding far below him on the surface of the earth; exerting pressure here and there, manifesting whirls and vortices in the endeavor to overcome material obstacles. The mathematical physicist in this day of theories of ions and electrons has approached nearer the earth and thinks of the stream as he might of a stream of human beings, each animated particle having numberless degrees of activity. This latter physicist stands for the mathematical physicist of to-day who deals in theories of electrons. Inside the general view given by hydrodynamical analogies there is coming into view a science of detail; a science of the dynamics of the electrical particle.

This closer view of the mechanism of electricity is entirely due to the study of discharges of electricity in rarefied gases, a subject which was unknown in the time of Franklin. This study taken in connection with the related subject of the passage of electricity through fluids or electrolytes has revealed the existence of small particles of matter which are charged with either positive or negative electricity and which are moving with great velocity. They are, therefore, carriers of electricity. One of the most notable contributions to this new idea of electricity can be found in two papers of Professor Townshend, of Oxford (*Phil. Mag.*, November, 1903, to December, 1904), on the sparking potential. To the student who has been greatly puzzled by the phenomenon of the electric spark this paper is most enlightening, for it gives a very rational theory of the mechanism involved.

Professor Townshend was led to his treatment of the subject by a consideration of the action of violet light on the electrical conductivity of a gas. By the action of the light a certain number of negative ions are set free which generate others in their passage through the gas. The computation of the number of negative ions reaching the positive plate or terminal when the distance traversed is small agrees with the theory of ionization; but for larger values of potential and greater distances, calculation shows that some other form of ionization comes into play. Professor Townshend is then led to the theory that all the ionization is produced by collision of positive and negative ions with neutral molecules in a uniform field of forces; a number of negative ions start from the negative plate or terminal, they generate others in the gas and a definite number reach the positive plate; the positive ions move in the opposite direction and also ionize the gas by collisions. Professor Townshend deduces on this theory an equation giving the number of ions produced, which agrees very closely with the results obtained by experiment. It is interesting to notice how a particular and detailed view of the dynamics of a particle here supplants the theory of a positive and a negative fluid moving in opposite directions.

While both the two-fluid theory and the one-fluid theory explain a large num-

ber of facts, it is noticeable that the main conception of the one-fluid theory is used in speaking of the flow of electrical currents in conductors. It is always a movement of something from A to B and not of a simultaneous movement of a similar something from B to A. The success of the ionization theories in opening new views of electrical action in the case of discharges in gases has led to an endeavor to explain electrical conduction in solid conductors by the movements of electrons or the negative corpuscles. This attempt is a far-reaching one, for it is leading those who write upon the dynamics of an electron to conceive of the mass of an electron as something of a purely electromagnetic nature. Electricity accumulates upon the volume element of the electron just as matter is supposed to reside in the volume element of what appeals to us as ordinary matter. It may be that all our conceptions of matter may become electrical conceptions; and that we shall come to an idea of knots in the ether.

The most notable utterances upon this electrical theory of matter during the year are contained in the addresses of the Right Hon. A. J. Balfour, Premier of England, and of Professor Horace Lamb, before the British association. These utterances, however, are chiefly philosophical.

Patent Progress During the Year.

By E. G. Siggers.

ACTIVITY has marked every branch, class and line of the electrical art during the past year, and this marked enterprise is probably most strongly evidenced by the great amount of work that has devolved on the three divisions of the Patent Office, given up entirely to the consideration of this important factor in the world's progress. The weekly official gazette published by the Patent Office fairly bristles with the names of inventors who have found fame and fortune by turning their ingenious minds to the consideration of means for making the great unknown force become more and more the well behaved and useful servant of mankind. The great electrical companies appear with almost weekly regularity as the owners and purchasers of patents, and then scattered through the year are those innumerable sporadic inventors, each of whom has hit upon a novel idea, a scheme, a thought, that ends in an invention, perhaps useful, perchance worthless, finally culminating in a patent. However, in all cases something additional is added to the art and presented to the consideration of the world, possibly to be rejected but always liable to be considered worthy of commendation and material favor.

The three electrical divisions in the Patent Office have over one thousand cases on their books which are awaiting their action, and there are undoubtedly at least as many more which have been acted upon and are awaiting responses from the various applicants. The divisions are behind in their work from two to four months, and thus some idea may be gained of the immense amount of labor devolving upon the examiners to properly examine and act upon the inventions presented for their consideration.

An investigation shows no generic or "epoch-making" inventions produced in the electrical world during the past year. Improvement has been the order of the day, and as one examiner has characterized it, the progress consists "mostly in threshing over old straw." Great activity has been shown in alternating-current motors, motor-control and the like, and considerable interest has been manifested in high-speed dynamos and rotary motors or steam turbines for running them. Third-rail systems, traction lines, and the various mechanisms pertaining thereto have received their quota of additional patents, the majority, perhaps, being controlled by the large manufacturing corporations.

In the art of wireless telegraphy, the feature that now appears to be commanding special attention is the production of means by which the distance of transmission can be extended. Thus, in the De Forest system, a successful and what may be termed official test has been made between St. Louis and Chicago, and it is reported that Captain Hogg, at Annapolis, Md., has successfully communicated with the Marconi station at Cape Cod, Mass. These results are considered highly gratifying, in view of the fact that the transmission of messages overland is computed as five to one when compared to the transmission of such messages over water. In other words, the restriction upon the former, due to the absorption of the current by the earth and other causes, is five times greater than under the latter conditions.

In the line of telephony and telegraphy, in general, the same activity as in the other branches has been displayed. Patents on improvements have been obtained in the classes of automatic, central and selective systems, to say nothing of the multitudinous details relating more particularly to the mechanical structures and elements, and forming an important feature of the art.

The case of electric lighting has come in for its share of patronage. The so-called Nernst and Hewitt lamps still attract the attention of inventors, the company controlling the latter having apparently branched into an analogous art, namely, that of current rectifiers, on which a number of patents were recently issued. As in the other classes, the present vigor in the art of electric lighting arises entirely from the improvements being made in the arrangement of parts, combinations, and the various mechanical details of construction.

Finally, there must be taken into consideration the progress of the patent world at large, and with which the electric art is so closely interwoven. There have been thousands of patents secured, where the novelty resides in structures, not relating, *per se,* to electricity, and yet wholly dependent for operativeness and success upon the same. The past year has been one of progress in all lines. The three-quarters of a million mark in patents was reached in January, 1904, and at the present writing, it appears that the year's issue has amounted to over 30,000. The past year was a banner one, so far as patents were concerned, and if the commercial conditions and present prospects remain as favorable during the present as they were during the past year, undoubtedly it, in its turn, will also be eclipsed.

SHORT-CIRCUIT ON THE LONDON SURFACE ELECTRIC RAILWAY SYSTEM—A small boy with an iron hoop, which he inserted into the slot of the London County Council's electric railway system, caused a short-circuit. The London *Electrician* says that the boy was not killed, as there was no member of the engineering staff near enough to do the deed!

Review of the Year in Great Britain and the Continent of Europe.

By C. L. Durand.

AS REGARDS electric light and power stations we find that a considerable number have been completed during the year, especially in Great Britain. The Northern Metropolitan Electric Power Supply Company has erected two stations of considerable size in London for operating a large tramway system. One of these, the Brimsdown power station, generates high-tension current at 11,000 volts. When complete it will have eight Babcock & Wilcox boilers, supplying steam to three 1,000-kilowatt Parsons steam turbine groups. Brown-Boveri alternators of 1,000 kilowatts each are used with these groups. High-tension current is sent to three substations in the city. In connection with this is the Willesden power plant, which also delivers current at 11,000 volts. It has four Babcock & Wilcox boilers and three direct-coupled units, one of 600 kilowatts and two of 300, with Ferranti engines and Westinghouse alternators. A 400-kilowatt Brush group is soon to be added. The Heston & Islesworth power plant has a dust-destroyer in connection with it. The plant is equipped with the water-tube boilers, two of which are heated by the dust-destroying furnaces. The dynamo room has two 200-horse-power engines coupled to 150-kilowatt dynamos. A third group of 400 kilowatts will shortly be erected. The Stoke electric lighting plant is another to use a refuse destroyer. It employs the three-wire system with 240 and 480 volts. The outfit comprises two Lancashire boilers and two Willans engines coupled to Dick-Kerr dynamos. The plant uses 300 horse-power at present.

On the Continent we note the two large stations at Budapest for lighting and power. The Schuckert company has installed one of these plants. It generates two-phase current at 2,000 volts and supplies it to three substations, where rotary converters lower it to 260 or 350 volts for the local circuits. A combined steam and hydraulic plant at Zurich may also be mentioned. The hydraulic outfit consists of ten turbines driving a common shaft. To this are connected four alternators. In connection with the former are several engine and dynamo sets, with three-phase, 2,200-volt Oerlikon alternators. A number of the Paris electric light and power plants are increasing their capacity. Among these may be mentioned the new Metropolitan station which is installing a second boiler room and a number of large generating sets with upright engines. The increase is needed to keep pace with the extension of the Metropolitan underground road. The tri-phase is a new plant in the suburbs which sends current to the city over a high-tension line. The Issy plant is installing four 600-kilowatt Westinghouse alternators to replace the machines of an older type and smaller capacity. These machines will run at 3,000 volts. A new substation of considerable size has been installed to supply the lighting current for the stations and tracks of the city belt railroad. It receives high-tension current from the Moulineaux central station.

A number of new hydraulic plants have been erected during the year, and some of the older stations have been increased by the addition of turbine units. In France, water power is used principally in the moutain region around Grenoble and also on the Mediterranean coast near Nice. In the former district may be noted two large plants which furnish current for the surrounding region. One of these is situated at Avigonnet and uses power from the Drac river, with a seventy-foot head of water. The station uses Piccard & Pictet (Swiss) turbines with Schuckert three-phase dynamos. These machines deliver 15,000 volts which is raised to 30,000 by a set of transformers placed in the station. Direct current is supplied to the La Mure electric road by a separate set, with a Thury dynamo. Not far from the preceding is a station located on the Bourne river which furnishes current for several towns in the region. The plant will contain six turbine units when completed. Schneider dynamos of 2,000 kilowatts are used here, and they furnish 4,000 volts, alternating current. This is raised to 36,000 volts by static transformers in the building. The Thomson-Houston company has lately installed a plant of some size not far from Nice; it is located at Plau du Var, where a ninety-foot head of water is secured from a mountain stream. Three Escher-Wyss (Swiss) turbine sets are used, with three-phase alternators of the company's make. These machines give 10,000 volts and operate at 400 revolutions per minute.

The Scotch water power syndicate which has lately been formed expects to develop hydraulic power in the mountain region of Scotland. Among the first plants it will erect is that of Loch Slog, and it expects to obtain a large amount of power from the lake. A dam will be erected at one end of the lake, which will raise its level by sixty feet. In this way they will secure at least 6,000 horse-power. An open canal and a penstock will bring the water to the station, giving a total head of 700 feet. High-tension lines at 4,000 volts will run through a flourishing industrial region which will no doubt use considerable power. Among the new hydraulic plants of Spain may be mentioned a large station which has recently been erected on the Ebro river by the Societa Hidrollectrica Iberica. It furnishes current for a fifty-mile high-tension line which runs to Bilbao, where the current is used for light and power. The power plant uses a seventy-foot head of water to run four 1,000-horse-power turbine and dynamo sets. Escher-Wyss turbines and Siemens & Halske dynamos are used. The latter are three-phase alternators delivering current at 3,000 volts. This is raised to 30,000 volts by step-up transformers. At Bilbao the line is received in a substation which lowers the voltage to 3,000. A second hydraulic plant is now in erection on the Ebro not far from the former. It will use a 130-foot fall and is designed for a capacity of 7,000 horse-power. Among other hydraulic plants recently erected in Spain may be mentioned the San Quirico station and another plant at Camdemola. At Vich, a 3,750-horse-power station is about completed. The falls of the Serge river are to be used for a high-tension plant which will distribute power throughout the region.

It is probable that the question of hydraulic power will soon be taken up in Russia, especially in the region near St. Petersburg. As to the total amount of power which the streams in Russia can furnish, this is estimated at no less than 10,000,000 kilowatts. There are twenty-four streams available, among which the Dnieper alone figures for 180,000 kilowatts. It is proposed to use the falls of the Vonoska region, near St. Petersburg, to furnish current for an extensive tramway system in the city.

We may also mention the new hydraulic

plant on the Rhine which a Swiss company is now constructing. It will obtain a 22,000-horse-power fall by means of a canal which is cut across a bend in the river. A large power consumption is assured in the surrounding district.

Electric traction on the main railroad lines is specially worthy of note, and in reviewing the past year we see that the three-phase system has made considerable progress. The Valtelline system of electric railroad is now operating very successfully. The Rete Adriatica Company has now taken definite control of the lines which the Ganz Electric Company had in charge during the first two years' run. The latter company recently delivered three new three-phase 1,600-horse-power locomotives for the road. They work on 3,000 volts and fifteen cycles. One feature is the use of a combined high-voltage and low-voltage motor on the same axle. The Valtelline railroad is soon to make a trial of the Finzi single-phase locomotive. The latter works at 3,000 volts, and takes current by a trolley. In Wales, three-phase locomotives are now running upon twenty-five miles of railroad between Port Madoc and Carnarvon. At present there are ten electric locomotives of 200 horse-power in use. Current is obtained from a 2,000-horse-power hydraulic plant, using a 1,050-foot fall. Current is generated at 1,000 volts, and twelve transformer posts along the railroad lower it to 600 volts for the motors. In Sweden it is proposed to use alternating-current locomotives on the government railroads. Preliminary experiments will be made on a stretch of track specially built for the purpose. Electric locomotives are to be supplied by the Siemens-Schuckert, the Westinghouse and the Allgemeine companies. The Stubaital railroad of Austria is the first on the Continent to use the single-phase system. Trains are made up of a motor-car and two trailers. The motor-car carries four single-phase motors of fifty horse-power each. The Union company, of Berlin, supplied the outfit. Current is obtained from a 5,000-horse-power hydraulic plant on the Sill river. The Oerlikon company will likely fit out an electric station on the St. Gothard railroad, from Ertsfeld to Bellinzona, on the three-phase system, using 15,000 volts and fifteen cycles, with transformers placed on the locomotives.

Regarding direct-current systems, we note the new locomotives which the British Thomson-Houston company recently furnished for the electrical section of the Newcastle railway. They are used for hauling freight trains, and resemble the locomotives which are used on the Orleans railroad in Paris. The Milan-Gallarate-Porto Cerisio railway system, which uses electric locomotives of the Thomson-Houston build, reports an increase of traffic and it is proposed to extend the line in the near future and run it as far as Lugano. We must not neglect to mention the London Metropolitan, which is making very satisfactory progress, also the different extensions of the Paris Metropolitan. A new branch of the latter was finished during the year. It uses a special fireproof locomotive equipped by the Westinghouse company.

In Russia, the St. Petersburg-Oranienbaum railroad, which is twenty-two miles long, is to run electric trains to take up part of the traffic. Russian engineers consider that electric traction could be used to good advantage on the Trans-Siberian railroad. The number of trains now running, forty to fifty per day, is not sufficient, but this can not be increased without using higher speeds, and for this the track would have to be built stronger. Electric trains would afford a good solution of the problem, at least over a part of the road. Denmark is to enter the field with a seventy-mile electric railroad which will run over a part of the island of Zealand.

Tramways have naturally had their share in the progress of the year. Among the new lines may be noted the large system which has been recently opened in the north of London, controlled by the Metropolitan Electric Tramways Company. Current is supplied from the Brimsdown and the Willesden stations above mentioned. The Wakefield & District tramway system is another one which opened lately. It contains a total of twenty-four miles of single track and connects with the Leeds tramway lines. The Maidstone corporation opened a traction line during the year. It uses 500-volt Dick-Kerr motors of thirty horse-power, mounted on Brill trucks. The Gruyère system in Switzerland is a three-phase line. It contains a number of branches, figuring about thirty miles in all. It uses 8,000-volt three-phase current which is supplied from a large hydraulic plant at Montbrun.

Among the new arc and incandescent lamps which have appeared during the year, we may note the Foster hot-wire arc, which is an English invention; it controls the movement of the carbons by the expansion and contraction of a pair of metal strips which are traversed by the current. One advantage is that it works equally well on direct or alternating current. One of the commercial types weighs but twelve pounds. The "Lilliput" arc, which Siemens & Halske brought out recently, has been followed by another small arc, the "Siva," constructed by Ehrig & Gratz. A new arc carbon invented in England is said to give good results. An inner core of carbon is surrounded by a layer of metallic salts and this in turn by an outer layer of compressed oxides. The latter serves as a sheath, while the carbon forms the arc and the light is increased by the vapors of the metallic salts. Carbons with different salts placed in a core in the centre, known as "intensive," are in use in various parts of Europe, and give a very pleasing light which is more diffused than the ordinary arc. As to incandescent lamps, the Allgemeine company, of Berlin, reports an increasing consumption of Nernst lamps. Some of the tests recently made on the Nernst lamp by the Hamburg inspectorate show a very good performance. The candle-power falls somewhat rapidly in the first twenty-five hours, but during the next 500 hours it holds up well. The efficiency remains between 2 and 2.5 watts per candle during several hundred hours. As regards photometry, we may mention the new method of Nisco. He uses a selenium cell with a galvanometer, but allows the light to fall on the cell intermittently. This he finds to give more constant results.

Electrochemistry and electrometallurgy have made considerable advances during the year both as to commercially working plants and new inventions and processes. Among the recent plants we may mention the new carbide works at Zwickau, Germany, which uses a hydraulic station to supply the current. Another successful plant is the Pappenburg electrometallurgical works, which is now producing copper and nickel by a modification of the Hoepfner process, using a solution of chloride. It turns out one ton of refined metal per day. The Gin electric furnace manufactures special low-carbon steels, containing nickel, manganese, vanadium or other metals, at a cost of sixteen dollars per ton of refined product. A prominent question is that of recovering tin from scrap. The Chem-Fabrik Elektron is using a new process at the Ploridsdorf works near Vienna, and the process is also employed at the Brenier metallurgical works in Germany. Caustic soda is used as the electrolyte. The Goldschmidt process with alkaline bath is now in use at Essen, Germany. A sulphuric acid

bath is employed in the Smith and Gutensohn process, and the tin is deposited on a copper cathode. Claus employs a hot solution of sulphostannate of soda for the bath, while Hemingway dissolves the tin in ferric sulphate in acid solution, and then deposits it on a copper plate.

Accumulators have been used on several of the new traction systems which have been opened during the year. A type of accumulator car is in successful operation on one of the Dresden suburban lines which forms part of the Saxony railways. The car holds ninety-eight passengers and has four axles, each equipped with a four-pole motor. There are 184 cells which are placed under the seats. The battery gives 430 ampere-hours at a 140-ampere discharge, and delivers 370 volts. Siemens & Halske have recently built an accumulator locomotive which contains 200 Hagen cells at 184-ampere-hour capacity at a two-hour discharge rate. The batteries are charged once a day at 110 volts and on the discharge they give 360 to 410 volts. A Swedish company is using Jungner cells on three large passenger automobiles which run between Nowkoping and Kneippbaden. They resemble the Edison cells, but are considerably larger. The active matter is a combination of iron and nickel hydrates placed in pockets in a sheet-steel plate. A perforated metal cover is then put on. The electrolyte is a twenty-per-cent caustic potash solution.

A satisfactory advance has been made in wireless telegraphy during the year. Italy is equipping a number of stations along the coast and in the interior of the country. The Monte Mario station at Rome and one in Sardinia will be used exclusively by the government, while public messages can be sent from the five other stations. The Bari station is one of the largest of these, and it has a range of nearly 400 miles. The Coltano station which is now building is to be a specially large one, and is intended to connect with South America. The Italian stations will signal to the different steamship lines, and most of the boats have apparatus on board. An extensive coast system is to be established in France. The Porquerolles station has now been opened to the public, and it will be followed by others on the Atlantic and Mediterranean coasts. The battleship St. Louis is said to hold the record for long-distance signaling, as it now covers 273 miles. A large station is to be erected at Constanza in Roumania which will communicate with ships in the Mediterranean. As regards Great Britain, we may mention the experiments which the army is carrying on in Wales near Carnarvon with the Lodge-Muirhead field apparatus. Signals are now sent between two stations placed twenty miles apart. In Germany a number of stations have been erected on the Slaby-Arco-Braun system.

An important point to be noted in the way of telephone developments is that the Pupin system is to be tried on some of the large interurban lines in Italy. The telephone system of St. Petersburg is now operating very satisfactorily and is now proposed to erect public telephone cabins in different parts of the city. At Vienna some experiments are being made with a new fireproof and sound-proof cabin which is claimed to be superior to anything now in use in this line. It is built of artificial stone tiles inserted in an iron framework. The new central telephone building which is about completed at Budapest has a capacity of 40,000 subscribers at the maximum, but will start with a much less number. The common battery system is used here. Wireless telephone experiments are being carried out in different parts of Europe. Professor Mosler, of Brunswick, Germany, uses a singing arc for this purpose and can signal from shore to boat at half a mile distance. Another system is used by Garcia in Spain. He places a microphone in series with an oscillator and thus modifies the character of the waves which the latter produces. The receiver is a Tommasi coherer combined with a telephone. As regards telegraphy, we may mention the agreement which the Danish government recently made with the Northern Telegraph Company as to the new Iceland cable. The cable will be landed on the east coast of the island and from this point a land line will run to Reykjavik, the principal locality. The other end of the cable will join on to the existing Danish cable at the Shetland Islands. A new invention which is worthy of note is the Orling-Armstrong electro-capillary recorder, which is intended to replace the siphon recorder. It is a modification of the Lippmann voltameter and contains a mercury column which rises and falls by the current. The image is projected on a screen so as to give a series of signals.

THE DESIGNING OF FIXTURES FOR MODERN LIGHTING.

BY A. H. PATTERSON.

In no line of useful wares entering into the furnishing and decorating of a house or building of any kind has greater or more rapid strides been made than in the designing and making of fixtures for gas and electric illumination.

It is not many years since the introduction of quality, appropriateness of design and finish, rather than bulk or massiveness, became a feature of fixtures for illumination, and there has been a steady advance and development, so that to-day the gas and electric fixtures are as correct features in appropriateness and harmony of design as are the other interior fittings and furnishings.

There is no exaggeration in the claim or statement that the fixture manufacturers of the United States to-day excel those of all other countries—in design, in finish and in features both decorative and useful.

Not only the fixtures must possess these truly artistic features and excellence of design and finish; but even the glassware accessories that are used with them, such as the globes, shades and imitation candles, must also possess the high qualities of harmonious design as do the fixtures on which they are to be used.

But a few years ago the highest example of a globe for a gas fixture, no matter what design it was an example of or how costly, was that known among dealers as a "Cut Crown," this being the highest type of a gas globe at that time. What a changed condition (and for the better) exists at the present time. Now the glassware used with lighting fixtures must possess character and appropriateness both as to the shape of the globe itself as well as the decoration placed upon it, and be in harmony with the fixtures—just as the fixtures must partake of the architectural and decorative features of the interior where they are to be placed and used.

American manufacturers engaged in these two lines can well feel a pride in their achievement, and the high class of goods produced by them; and also be congratulated for their continued effort in the application of real art (a much abused word) to their productions; thus keeping in close touch with and catering to the rapidly growing taste for and development of all that is "true art," as applied to the articles they manufacture —true allies of other lines devoted to the furnishing and decoration of interiors—each of which, in its line, makes possible "The House Beautiful."

Some Continental Central Stations Operating with Gas Engines.

By Franz Koester.

THE CENTRAL STATION AT ROMANSHORN.

AT THE time when the plans were being prepared for the installation of a pumping station at Romanshorn, Switzerland, attention was drawn to the advantages accruing from a combination of a central electric generating station with the hydraulic plant, the central station furnishing the current for lighting the railroad yard and the harbor of Romanshorn.

After careful study of the question, the company decided to combine the two enterprises and took the name of Wasser und Elektrizitatswerk, Romanshorn.

The enterprise had been encouraged at the start by the fact that the Railroad Company of the Northwest had contracted in advance to install twenty-eight arc lamps, representing a total of 28,000 candle-power, and 150 incandescent lamps, with a total of 2,400 candle-power. Further than this, the town of Romanshorn contracted in advance for 1,280 candle-power for street lighting. Later the town of Amrisweil contracted to take $2,400 worth of light per year, and the number of new contracts increased so rapidly that an important extension of the original plant was rendered necessary. On this account there were added to the plant equipment a single-phase alternator of sixty horse-power which served to supply current for incandescent lamps, and also two continuous-current generators of fifteen horse-power each for supplying current to the arc lamp circuits.

At the same time that the company decided to enlarge the power-house it also decided to furnish current during the day for operating motors, as many demands for this class of service had been made, and instead of using single-phase alternating current, which had been previously employed, it decided to introduce with the new installation a three-phase system which makes possible a more advantageous distribution.

In order to avoid making a complete change in the secondary wiring system and in the transformers which were already in place, it has kept the transformers as well as the secondary wiring and has divided, as equally as possible, the transformers for the single-phase current upon three conductors of the primary three-phase line; the new transformers being for the three-phase system. As soon as the new building was completed work was commenced on the installation of new gas engines, and later on the installation of the dynamos. The first group of machines was in regular operation inside of four months, and the second group and the transformer station inside of five months. The plans provide for a later installation of a third group similar to the first two.

The work on the line to Amrisweil was completed and the line in operation for regular service within two and one-half months after the beginning of the work. The first gas engines were manufactured by Crossley Brothers, Limited, the two new engines by the factory of Dentz. The entire electric installation was obtained from the works of the Oerlikon Construction Company, of Switzerland.

The power-house is built on the banks of lake Constance, about the centre of the town, and so close to the railroad line as to be most convenient for the delivery of the fuel supply. The ground floor is divided into three distinct parts: the engine room containing 399 square metres, in which are located the pumps, gas engines, generators and switchboards; the second part containing 160 square metres, in which is installed the gas-producing apparatus; and the third part, consisting of a workshop, containing 120 square metres.

The engine room is spanned by two hand-operated traveling cranes of 2,000-kilogramme capacity each. At the side of the building there is a coal-shed connected to the gas-producing room by a narrow-gauge track. The gas-generating apparatus consists of three Hirzel producers, and a fourth, recently procured from the factory of Dentz, the total capacity being 250 horse-power.

The process of gas production is as follows: from two vertical boilers superheated steam of six-atmosphere pressure is raised and led to the generators which are provided with steam-jet blowers, and in passing through these blowers the steam carries with it the air necessary for the formation of the gas. This mixture of steam and air passes over the mass of burning coals in the generators, where it is converted into gas. The gas is composed of about forty per cent of combustible parts (CO, and H). After leaving the generators the gas is purified by introducing it at the bottom of a scrubber filled with coke and which is provided with a water-spray. From the scrubber the gas is passed through filters filled with sawdust and it is then led to a common storage tank having a capacity of fifteen cubic metres. From this storage tank are led the feed-pipes for the engines.

At the northern extremity of the engine room are two Crossley gas engines of sixty

EXTERIOR VIEW OF THE "ROMANSHORN, SWITZERLAND," GAS-ENGINE-DRIVEN CENTRAL STATION.

and forty horse-power, respectively. They drive a transmission shaft by means of pulleys and belts. From this shaft are driven a plunger-pump, located in the cellar, and also a generator. At the side of the plunger-pump there is a high-pressure centrifugal pump coupled to a three-phase-motor, which will be mentioned later.

The southern side of the power-house is occupied by two gas engines furnished from the factory of Dentz. They are twin horizontal machines with the fly-wheel in the centre and are belted to the generators. At 180 revolutions per minute these engines have a normal capacity of 120 horse-power, and a maximum of 140 horse-power. Each engine is provided with an admission and an exhaust valve, a gas valve under control of the governor and an electric ignitor. The engines are started by means of compressed air, and for this purpose there is placed in one corner of the building an air compressor operated by a vertical gas engine of two horse-power.

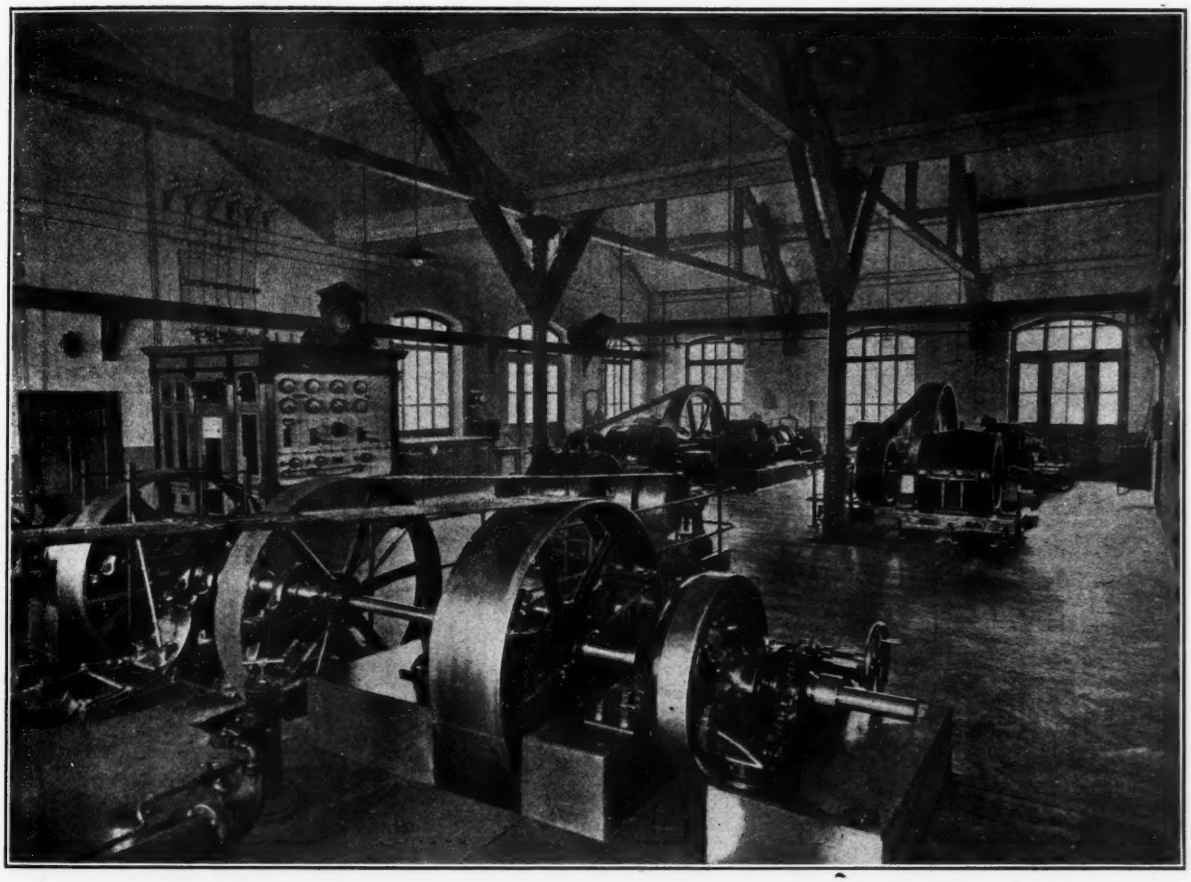
This compressor is used to fill a tank which has a capacity of about 400 litres, the pressure varying from eight to ten atmospheres. This requires about thirty minutes' work on the part of the small engine. The generators operated from the intermediate shaft are of the Oerlikon type, and they run normally at 600 revolutions per minute and produce three-phase currents at 2,250 volts and fifty cycles.

Each of the two halves of the armature is connected in series and contains fifteen coils placed in thirty slots. Each coil is composed of forty-eight turns of copper wire 2.8 by 3.4 millimetres. The exciter is of the same type as that of the large generators and is mounted upon the shaft of the machine. The two alternators operated by the Dentz engines are of the Oerlikon type, and at a speed of 5,000 revolutions per minute furnish three-phase currents at 2,250 volts and fifty cycles per second. Each half of the armature carries eighteen coils, each coil consisting of twenty-five turns of copper wire 4.2 by 4.8 millimetres, the two halves being connected in series.

The switchboard consists of five marble panels carried on an iron framework and is provided with all the apparatus necessary for the four generators and the distribution system. The centre panel is reserved for the distribution system, three other panels carry the apparatus and measuring instruments for the generators; for instance, one ammeter, one voltmeter, one switch and a hand-wheel for the field rheostat.

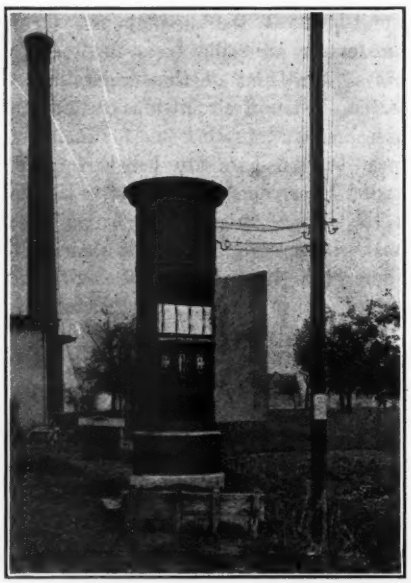
Behind the switchboard are located the circuit-breakers, the rheostats, measuring transformers and the fuses for the machines. In front of this apparatus are located the main circuit-breakers for the three lines and an ammeter for each line. From the bus-bars are led three high-tension lines, one feeding a transformer in the power-house, the other going to Romanshorn, and the third to Amrisweil. Where the line crosses the railroad, bridges have been constructed in order to avoid any accidents which may result from the breaking of a cable. The line to Romanshorn consists of three conductors five and one-half millimetres in diameter, that to Amrisweil three conductors eight and one-half millimetres in diameter. The wires are fastened to porcelain insulators and carried on wooden poles. In the Romanshorn line 270 poles are used, and 340 in the line to Amrisweil; the length of these being respectively 4,700 metres and 7,200 metres.

The conductors which feed the transformers for the line are equipped with circuit-breakers carried on wooden poles.



INTERIOR OF POWER-HOUSE, GAS-ENGINE-DRIVEN CENTRAL STATION, AT "ROMANSHORN," SWITZERLAND.

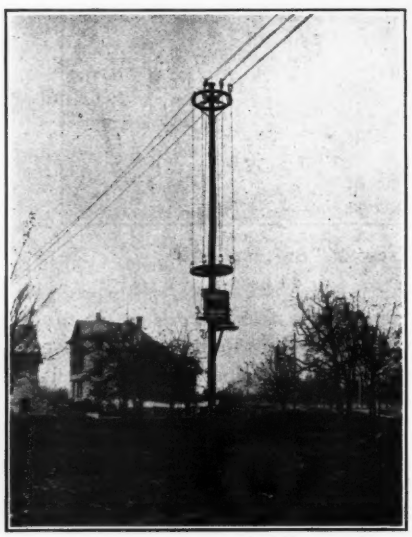
this arrangement allowing a transformer to be cut out if necessary. The transformers are placed in special buildings,



TRANSFORMER HOUSE ON THE "ROMANSHORN," SWITZERLAND, LINE.

there being six at Romanshorn and four at Amrisweil.

The transformer in the power-house furnishes current at 190 volts to the motor which operates the pump. The transformer station in the engine house consists of three transformers, of which one (2,250 to 190 volts) supplies the motor of a motor-generator group and the two others (2,250 to 110 volts) furnish the current for the incandescent lamps.



HIGH-TENSION FUSES AND CIRCUIT-BREAKERS ON THE "ROMANSHORN," SWITZERLAND, LINE.

At Romanshorn the secondary current is distributed partly as single-phase and partly as three-phase, while at Amrisweil three-phase currents alone are employed. In the former instance the secondary line is 6,500 metres long, and in the latter 5,100 metres. The motor-generator group consists of a three-phase motor of twenty-eight horse-power which operates two fifteen-horse-power, continuous-current generators, the motor being coupled to the generators by elastic insulating couplings. These machines were originally located in the power-house, but as the continuous current was used entirely for the arc lamps which are located at the railroad station and at the harbor, it was finally decided that in order to diminish the loss in the line and to obtain a steady light to transfer the motor-generator group to the locomotive round-house.

A small switchboard located near the machines carries the necessary measuring instruments and apparatus. Besides the motor cited above, there is also a three-phase motor of twenty-eight horse-power installed in the power-house itself. This motor operates a plunger-pump which raises the water to a height of seventy-four metres. The pump runs at a speed of 980 revolutions per minute. In addition there are also connected upon the line ten other motors with a total of thirty horse-power which are used for various industries.

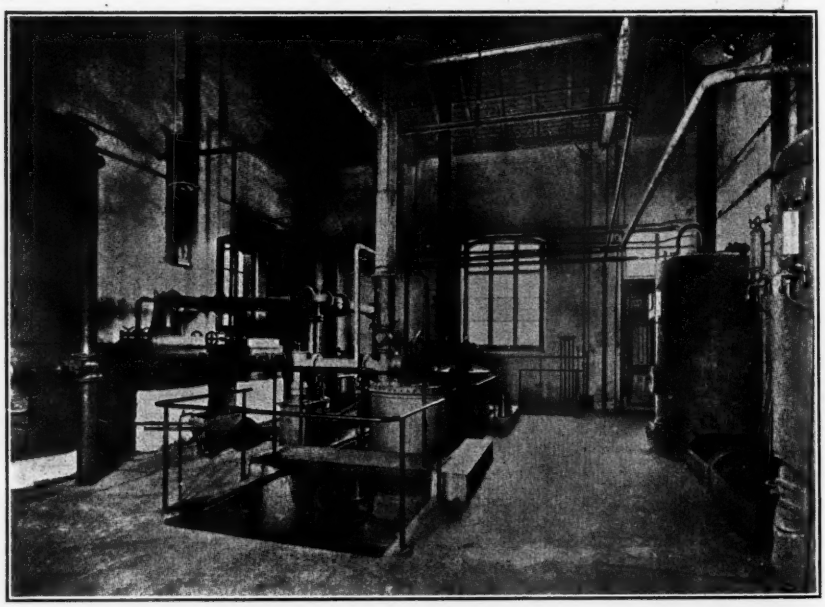
The lighting system comprises thirty arc lamps and 3,669 incandescent lamps, representing a total of 44,978 candles.

LIGHT AND POWER DISTRIBUTION AT USTER, SWITZERLAND.

The town of Uster is situated near lake Greifen in the canton of Zurich. In order that the industries of the town should continue it was necessary to create a source of power for the mills. The town recognized this necessity and decided upon the construction of an electric plant.

A special commission for studying the question was appointed and they decided to build a power plant which would furnish current for lighting and power purposes. The furnishing of the complete electrical equipment and the work of installation were placed in the hands of the Oerlikon Construction Company.

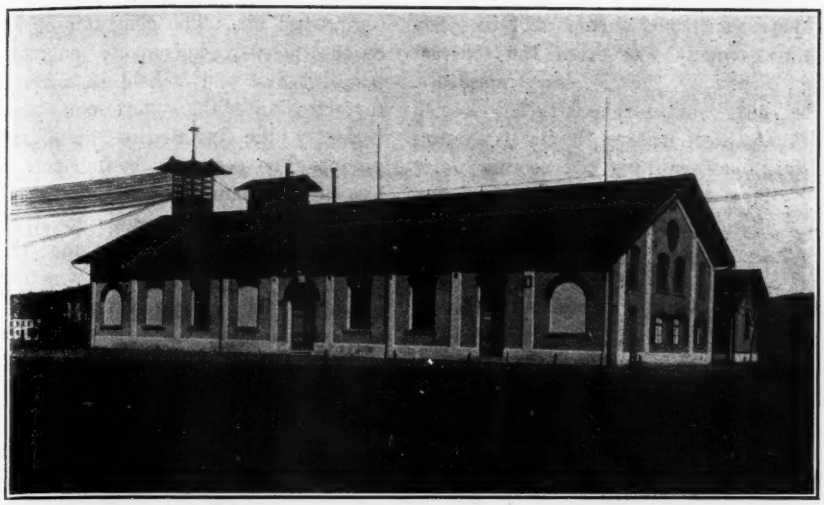
The building erected contains a room for the Dowson gas generators (117 square metres), the engine room (234 square metres), the storage battery room (seventy-three square metres), a coal storage room (thirty-six and one-half square metres), and a room for the gas-holders (thirty-six and one-half square metres).



GAS GENERATOR ROOM OF THE "USTER," SWITZERLAND, POWER PLANT.

Below the coal storage is a reservoir for the cooling water for the cylinders. The gas generators, as well as the two gas engines, were furnished by the Dentz company. Each of the two generators can produce sufficient gas for one 125-horse-power engine, and in addition there have been installed a steam boiler and the necessary apparatus for purifying the gas. Provision has been made for a third generator and the necessary purifiers. The storage tank has a capacity of thirty cubic metres. The two gas engines have each a normal output of eighty horse-power, but can furnish 100 horse-power. They are both connected to the dynamos. The gas is ignited by means of an electric spark, the current being furnished by the storage batteries. The engines are started

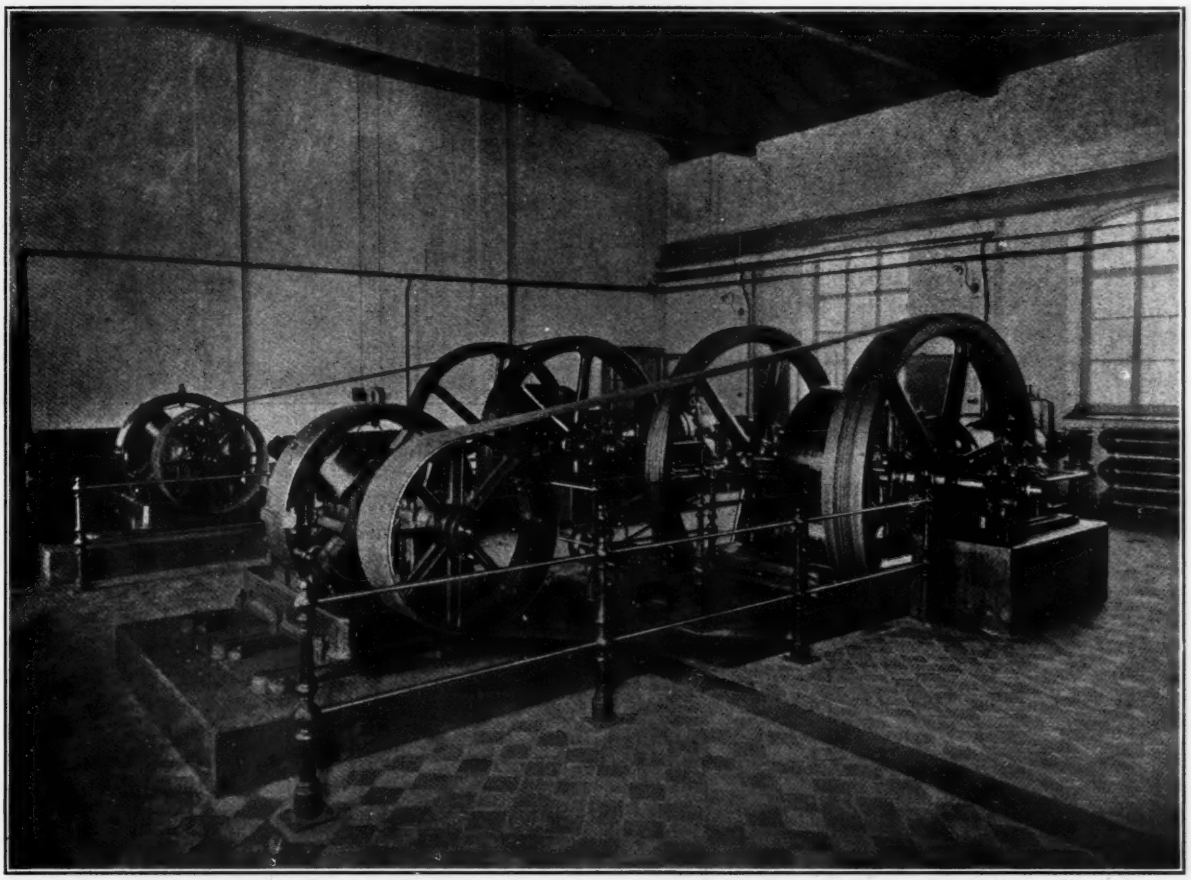
by means of compressed air. Each engine is furnished with two flywheels, one of which acts as a pulley. The generators are shunt-wound and built by the Oerlikon company. They operate at a speed of 560 revolutions per minute and furnish a direct current of 200 amperes per commutator, of which there are two. The voltage at the brushes of one of the commutators can be varied between 125 and 175 volts, and a special arrangement permits of connecting the two collectors of the same machine either in series or in parallel, thus allowing the two halves of a storage battery to be charged either in series or each half separately. The storage battery is composed of two sets of seventy elements and has a capacity of 800 ampere-hours.



THE "USTER," SWITZERLAND, GAS-ENGINE-DRIVEN CENTRAL STATION.

The diameter of the armature is 520 millimetres and the length 360 millimetres. The armature has 116 slots 6.5 by 2.4 millimetres. Each slot carries two conductors 4.7 by 5.2 millimetres. Each commutator is composed of 116 laminations of copper separated by strips of mica 0.6 of a millimetre thick. The field bobbins on the four spools are connected in series and consist of 968 turns, wound in sixteen layers, the wire being 2.2 by 2.6 millimetres.

From the generators the current is led to the switchboard which carries the measuring instruments and the necessary safety apparatus. It also carries two automatic regulators, one for each half of the battery. Interrupters and switches, by means of which the generators may be thrown either on the line or on the battery, or the generators and battery arranged to operate in parallel upon the line, are provided. This arrangement, which is both ingenious and practical, permits of obtaining during the periods of heavy load a current almost double that which would be obtained from the generators alone. The distribution system is common for light and power, and is built with three conductors. The voltage between the extreme conductors



INTERIOR VIEW OF ENGINE ROOM, "USTER," SWITZERLAND, GAS POWER CENTRAL STATION.

which are used for the motors is 250. The lamps are operated at 125 volts. Both incandescent and arc lamps are used, there being 2,565 incandescent and eight arc lamps. The aggregate number of motors on the system is twenty-one, representing a total of 140 horse-power.

During the morning the generators are run until the battery is charged, this requiring more or less time according to the season. In the afternoon the power plant is in operation from four to six hours, the time varying according to the season. During the night the battery alone furnishes the necessary current. Three men are required to run the plant, two of them being always on duty. For lighting current three tariff schedules have been adopted.

TARIFF I.

For a lamp of	5	c.-p.,	0.24	cent	per hr.
" "	10	"	0.40	"	"
" "	16	"	0.64	"	"
" "	25	"	1.00	"	"
" "	32	"	1.28	"	"

TARIFF II.

For a lamp of	5	c.-p.,	1.6	dollars	per yr.
" "	10	"	3.2	"	"
" "	16	"	5.0	"	"
" "	25	"	8.0	"	"
" "	32	"	10.0	"	"

TARIFF III.

In cases where a meter is used current is charged for at the rate of sixty-four centimes, or 12.8 cents per kilowatt-hour.

For a factory where current is used eleven hours per day, Sundays and holidays excepted, the fundamental tax is three cents per effective horse-power per hour. Upon this price are given the following reductions:

Horse-Power.	Kilowatts.	Reduction. Per Cent.
1	0.9	1
2	1.8	2
3	2.7	3
4	3.6	4
6	5.4	6
8	7.2	8
10	9.0	10
12	10.8	12
14	12.6	14
16	14.4	16
18	16.2	18
20	18.0	20

For a greater consumption the price is fixed in advance.

DISTRIBUTION OF ELECTRICITY FOR LIGHT AND POWER AT STÄFA, SWITZERLAND.

The town of Stäfa contains about 4,000 inhabitants and is located on the right bank of the lake of Zurich. With the exception of some large factories which have their own electric plants, the town, up to the time of the installation of the plant here described, was lighted by petroleum lamps. The insufficiency of these latter gave rise to a desire for a more practical and less dangerous lighting system. The number of small industries in the town being sufficiently great to warrant a power plant, the plan of joining the lighting system with that of a power distribution system was considered and adopted. It was decided to employ continuous current and the Oerlikon company was given the contract for furnishing the necessary machines. The power-house was constructed close to the lake, after making the necessary provision for furnishing the cooling water for the engines. The power-house is of masonry construction and contains three rooms, one for the gas generators (55.6 square metres), the engine room (eighty-four square metres), and the storage battery room (27.6 square metres). The latter is divided into two compartments, one above the other, and each contains one-half of the elements. The lower room is accessible from the engine room, while entrance to the upper room is obtained through the gas-generator room.

ENGINE ROOM OF THE "STÄFA," SWITZERLAND, GAS ENGINE POWER PLANT.

The size of the gas-producing apparatus is sufficient to furnish gas for engines of a total of ninety-five horse-power. In the engine room are two gas motors of sixty and thirty-five horse-power, respectively, built by the Société Suisse de Lokomotives at Winterthour. Each engine is provided with a flywheel which is used as a pulley. The flywheel of the smaller engine is 2,600 millimetres in diameter and makes 180 revolutions per minute. That of the larger engine is 3,000 millimetres in diameter and makes 160 revolutions per minute. The cylinder diameters are 300 and 370 millimetres, respectively. The effect of the governor is such that with variations of load on the engine the proportions of the mixture of the gas and air are changed.

Both engines are started by means of compressed air. The generator operated by the thirty-five-horse-power engine was installed first and is held in reserve, as the extension of the system soon rendered necessary the installation of a larger group. The generator is four-pole, and has two commutators. It requires thirty-five horse-power and runs at 1,150 revolutions per minute. At the end of the shaft is a pulley 430 millimetres in diameter. The voltage at the brushes on each commutator can be varied between 120 and 175 volts, and the two commutators may be connected either in series or in parallel in order that the two halves of the battery may be charged together or separately. The construction of these generators with these commutators is no more complicated than that of generators with but one, and the operation is also quite as simple.

The diameter of the armature cord is 390 millimetres and the length is 270 millimetres. The armature contains 138 slots 21 by 4.8 millimetres, each slot holding two conductors composed of two wires in parallel, the wires being 3.4 by 4 millimetres.

The exciting current is obtained from one of the commutators. Each commutator is composed of sixty-nine bars of copper, insulated from each other by strips of mica 0.6 millimetre thick; the diameter of the pole bore is 404 millimetres, the

field consisting of four bobbins connected in series, each of which consists of 609 turns of copper wire 2.2 by 2.6 millimetres. The sixty-horse-power gas engine drives two four-pole generators which absorb thirty horse-power each and which are on the same shaft. They run at a speed of 1,100 revolutions per minute. Each generator furnishes a maximum current of 160 amperes, the tension varying from 120 to 175 volts. The generators are mounted upon the same bed-plate and carry on the shaft between them a common pulley 430 millimetres in diameter and 350 millimetres face.

The diameter of the armature is 316 millimetres and the length of the iron is 250 millimetres. The armature has eight slots of 6 by 20 millimetres each, enclosing two conductors composed of two wires 4 by 4.6 millimetres in parallel. The commutator is built up of eighty-one copper bars insulated by strips of mica 0.6 millimetre thick. The diameter of the pole bore is 324 millimetres. Each pole carries a coil composed of 725 turns, the four coils being connected in series.

From the generators the current is led to the switchboard which carries the necessary measuring instruments for each machine. There are also two automatic regulators, one for each half of the battery, and switches which allow the generators to be thrown on the battery or directly on the line. The three-wire system of distribution is used, the same lines answering for both light and power. The pressure between the two outside conductors is 240 volts, this pressure being used for motors and for the lamps for public lighting. Other lamps for private lighting are connected between one outside and the central conductor and which gives a pressure of 120 volts.

Five main circuits are led out from the central station, of which three are composed of four wires seven millimetres in diameter, one circuit with two wires eight millimetres in diameter, and one seven millimetres in diameter, and a sixth circuit consisting of three wires six millimetres in diameter. An additional circuit of three wires four millimetres in diameter is led from the power-house and is used to balance the current in the system. One line from this station serves all the lamps for public lighting. The lines are carried either upon poles or are fastened to houses. Each pole is furnished with a lightning-rod. At all railroad crossings the lines are run underground. The battery is composed of two parts of seventy elements and has a capacity of 540 ampere-hours. There are used 1,350 incandescent lamps, representing a total of 17,000 candle-power, and seven motors, representing twenty-five horse-power, are connected to the line.

During the morning the generators operate to charge the battery, this requiring more or less time according to the season. The generators are also operated from four to six hours in the afternoon, while during the night the battery is able to furnish the necessary current. The annual charges for ten-candle-power lamps are given in the following table:

	Hours Lamps are in Use.	Charge.
Sparsely settled localities.	1 to 250	$1.00
Residences	250 to 500	2.00
Stores	500 to 800	3.20
Restaurants	800 to 1000	4.00

Where a large number of lamps are used in residences meters are employed and the current paid for at the following rates:

	Charge per Kw.
For a consumption of less than $20 00 worth of current	17 cents.
For a consumption of more than $20.00 worth of current	14 cents.
For restaurants	13 cents.

For motors operating eleven hours a day, Sundays and holidays excepted, the rates are as follows:

Size, Horse-Power.	Price per Horse-Power-Hour.
½ to 2	3.0 cents.
2 to 4	2.8 "
4 to 6	2.6 "
6 to 12	2.4 "

Early Cable Work.

In an interview with Mr. Henry A. Reed, one of the pioneers in the manufacture of cable insulation, an interesting fact developed as to the use of the first cable. Said he:

"This cable was of No. 9 iron wire, insulated to the thickness of half an inch and was made in 1847 by Stephen Armstrong in Brooklyn, N. Y. It was laid across the North river at about Fort Lee. It only worked a few days when it was dragged out of place by a ship's anchor.

"The first iron-armored cable was made by S. C. Bishop in 1852, and was used across the North river, above Cold Spring. This cable was of No. 14 copper wire with an insulation the size of No. 0, protected by jute and armored with iron wire about No. 8.

"It's a matter of common history that the year before, the first iron-armored cable was laid across the Straits of Dover."

In an interesting collection pertaining to the early history of cable work Mr. Reed has a piece of gutta-percha cable encased in lead, used by the Prussian government in 1847. This was the first gutta-percha cable used underground of which record exists. This was brought from Berlin by Tall P. Schaffer in 1856, and was used by S. C. Bishop in opposing the granting of the Simpson patent. It was also used by Mr. Henry A. Reed, the present manager of the Bishop company, in defeating the Colgate suit for infringement against the Bishop estate in 1878-1880.

Steam Turbines for Driving Dynamos.

In referring to the employment of steam turbines for driving dynamos, in his presidential address, delivered before the Manchester section of the Institution of Electrical Engineers, of Great Britain, Mr. C. D. Taite said in part as follows: "The manufacture of direct-current dynamos suitable for the high speeds at which turbines have to be run has not yet become general practice, although there are a fair number of successful turbo-driven direct-current generators in operation, but, generally speaking, they are of comparatively small size. It is now clear, however, that turbo-alternators can be satisfactorily designed and built for almost any power, and we shall shortly have running the power station of the underground railways in London, equipped with ten 5,500-kilowatt turbo-alternators, these machines being capable of carrying a load of fifty per cent above that at which they are rated. The advantages of turbines have been enumerated so frequently that there is no need to tabulate them here. I would only call attention to two of them, *viz.*, the great capacity they have for overloads, and, secondly, the saving in capital expenditure which their adoption renders possible. A fifty per cent overload can be maintained permanently on a turbine with little loss of efficiency, the principal loss being generally in the reduced vacuum. It is, therefore, important when ordering turbo-driven plants to specify for ample margin in the generator, in order to take advantage of the overload capacity of the turbine, a feature likely to be of the utmost utility in central station work. With regard to the reduced capital expenditure required with turbo-driven plants, it is obvious that the plant itself costs much less than a slow-speed set of similar output, and owing to the reduced weight, the even turning moment, and the absence of all downward thrust, the foundation can be made much lighter. Again, a turbine plant—even of the vertical type—can be housed in a comparatively low building, and the floor space occupied is a minimum. On the other hand, in order to get the best results from a turbine, an ample water supply for condensing purposes is essential, and this to some extent restricts the choice of a suitable site. As regards coal consumption, the advocates of turbines and of reciprocating engines both claim the best results for the type which they favor, but I think that one will not be far wrong in stating that with regard to this feature there is little to choose between the two types, when both are working under suitable conditions."

ELECTROLYTIC PREPARATION OF TIN PASTE.[1]

BY F. GELSTHARP.

Tin paste is used for the production of metallic or silvered paper, having the appearance of tin or lead-foil, and it is also used for ornamental purposes. As I believe members are interested in any process in which electrochemistry advantageously takes the place of the older chemical methods, I beg to bring before the Faraday Society the following description of a process for manufacturing tin paste which was specially designed for a firm of paper-makers. The oldest method of making tin paste was that carried out by the natives of India. They melted block tin at a high temperature, and poured it into a wooden box, which was then shaken vigorously, the tin was thus converted into very fine shot and dust. The finer particles which they used for the paste were separated from the coarser granules by gravitation by means of water. It was afterward dried and mixed with a weak solution of glue, and in this state it was ready for use. This they used as a paint, the article to be ornamented was coated with it, and after being dried it was burnished.

The chemical process for making tin paste, as generally carried out in England, is as follows: the commercial ingot is reduced to what is known as feather tin by melting it, and then allowing it to fall some distance. The tin in this form is dissolved in strong hydrochloric acid, with the aid of heat, in copper vessels, and a concentrated solution of stannous chloride thus obtained. The liquid is diluted, and the tin precipitated in the form of paste by introducing metallic zinc. The process is troublesome on account of the fumes, and, moreover, does not give the whole of the precipitated tin in the form of paste, but partly as bright metallic feathers and crystals, which have to be worked over again; whereas in working the electrolytic process about to be described there are no fumes, and the paste is perfect in every respect. Further, the process is not so costly and can be worked continuously, the deposited paste being removed at intervals without stopping the current.

The electrolytic process is similar to the electrorefining of metals. Anodes of tin are dissolved in an electrolyte of dilute hydrochloric acid, and the tin is deposited in the form of a sponge or paste on cathodes of the same metal. The spongy deposit is lighter than the electrolyte, on account of the hydrogen it contains, and consequently floats on the surface of the solution after being detached from the face of the cathodes, so that it can be conveniently removed without breaking the current.

An apparatus capable of producing twenty hundredweight of tin paste per week consists of a generating plant giving 1,500 amperes at eight to ten volts. There are five vats, which are worked in series and are made of slate or pitch-pine wood 106 by 106 by 91.5 centimetres deep (three feet six inches by three feet six inches by three feet deep), each containing four anodes and five cathodes coupled in parallel. The anode plates are about 2.5 centimetres (one inch) thick, roughly cast from commercial ingots of tin; the surface exposed to the electrolyte being 91.5 by 76 centimetres (three feet by two feet six inches). The cathode plates are of block tin or tinned iron, the active surface being 91.5 by 76 centimetres (three feet by two feet six inches). The anodes are supported at the two top corners, and in each vat are all connected to one conductor. The cathodes are supported by and soldered to copper conductors, which are all connected to a main conductor. These main conductors are circular copper bars 3.2 centimetres (one and one-quarter inches in diameter). The electrolyte is a dilute solution of hydrochloric acid in five degrees Tw., which must be free from arsenic. The current density is 270 amperes per square metre, or twenty-five amperes per square foot of cathode surface.

As the anodes are dissolved away they are removed before they crumble and fall to pieces, and what remains of them is melted up with fresh ingots and cast to form new anodes. The electrolyte is kept in circulation by means of a small turbine or plunger pump of lead or block tin, driven by a small motor; the liquid is drawn from the bottom of the vats and discharged into the top; this is found necessary, as otherwise the electrolyte at the bottom of the vats would soon become very rich in tin, and instead of tin paste at the lower parts of the cathodes there would be crystal or leaf tin deposited.

When the deposited tin sponge has grown to about an inch in thickness it is detached from the cathodes by means of a T-shaped scraper, which is pushed down the face of the cathode plates; the floating, spongy tin is removed from the surface of the vat by means of a perforated scoop to prevent short-circuiting of the current through the floating tin; the cathode plates are varnished or painted with a non-conducting material from 5 to 7.5 centimetres (two or three inches) below the surface line. The tin paste is allowed to drain, and is then thoroughly washed with water and dried to make it ready for use.

This may not seem to be an efficient way of utilizing the electric current, because the current-efficiency is only about fifty per cent; but any attempt that I have made to produce tin in the form of paste or sponge at a higher efficiency has been futile; it appears to be necessary to have hydrogen deposited along with the tin, for when no hydrogen is deposited the tin comes down in a crystalline or bright leaf-like form.

[1] Paper read before the Faraday Society, London, England, December 19, 1904.

Utilizing the Magnetic Pull of Dynamos for Adjustment Purposes.

Quoting from a German contemporary, the London *Electrician* describes an instructive case where the air-gap of a 2,400-kilowatt, three-phase alternator was adjusted by utilizing the magnetic attraction between stator and rotor. The generator is driven by a horizontal steam engine, and from the very beginning it appears that the air-gap on the steam-engine side measured only four and one-half millimetres, while the gap on the opposite side was five and one-half millimetres. During the course of two years' operation the one-sided pull produced by these conditions caused the bearing to wear away on one side, and the rotating part shifted three-quarters of a millimetre toward the engine. The diameter of the shaft is 19.65 inches. Short-circuits now occurred more and more frequently, and when it was found that the stator frame had shifted bodily, and that the rotating part touched the stationary part, the generating set was shut down at once; but it was necessary to get it in operation again as soon as possible. The station is served by a traveling crane, but this machine has been designed for twenty-five tons only, and as the stationary portion of the generator weighs fifty-one and one-half tons, it was necessary to find other means for shifting the magnet frame. There was some hesitation about using jacks for pushing the frame over, as it was feared this would cause distortion. It was then decided to make use of the magnetic pull, which could be set between the rotor and the stator so as to equalize the air-gap. To do this a current was sent through one-half of the rotor. This current caused a one-sided pull upward at an angle of forty-five degrees to the horizontal. When the current through the rotor reached eighty amperes, the frame began to move, and by cautiously varying this current a fine adjustment was obtained, the time required for resetting the frame in its original position being but one and one-half hours.

A Review of the Storage Battery Situation for the Year 1904.

By Lamar Lyndon.

THERE have been few, if any, important changes or improvements in the storage battery art during the past year. The alkaline batteries so widely heralded, and on behalf of which so much was promised, have, so far, entered but little into the commercial field. The lead battery manufacturers continue to do business at the same old stand and the shareholders in the various battery companies seem to be reasonably well satisfied with the financial results for the year.

One of the events of the year is the final completion of the organization, technical details and factory of a new battery manufacturing company which has for four years been engaged in the long and expensive preliminary work required to prepare for actual business. With a high-grade battery, a well equipped factory, a complete line of auxiliary devices and large capital, it promises to become an important factor in the battery trade. According to verified reports the business announcement of this new corporation will shortly appear and it will actively enter the field within the next thirty days.

There has been a marked change in the methods of regulating automatic boosters. Booster-controlling batteries which regulate fluctuating loads, have heretofore been arranged to vary their voltages automatically with load changes, by passing the load current, or a part thereof, through series windings on the field-poles of the booster itself or of a separate exciting dynamo which energizes the booster field. This requires windings of large cross-section and necessitates the use of large frames with field-poles of excessive length for comparatively small outputs. Furthermore, such boosters do not compensate for changes in condition of the battery with respect to age, temperature, electrolyte density and state of charge, all of which may act to change the required booster voltage for a given load.

The recent boosters have on their fields ordinary shunt-windings with resistances interposed in the field-circuit, which resistances are automatically varied by a solenoid, the core of which is spring opposed, and the winding of which is energized by the load current. The solenoid core, therefore, varies its pull with variation in load, and thereby varies the resistances in the booster field-circuit and in this manner the booster voltage is made to correspond to the load requirements. This method is a distinct improvement, in that smaller machines without special windings may be used, which work at a higher efficiency and the regulation is better, the operation of the system being such that the condition of the battery is compensated for.

It is safe to say that the year 1904 marks the passing of the booster excited directly from the load current.

Despite predictions made a year or two ago that the Planté negative plate would be discarded for the pasted negative, the former is still in extensive use and there are no present indications that it will pass out of commercial existence.

In motor-car batteries the state of the art remains practically unchanged, and there have been within the past year no modifications worth noting, excepting, perhaps, the extension of the use of the wood separator which is now general practice. Manufacturers have learned that business is not improved by promises of unperformable mileages, and the ratings of motor-car batteries have been appreciably reduced.

A better understanding of the necessities of the user on the part of the maker and of the requirements as to care and handling of the battery on the part of the user, have brought about a more satisfactory commercial condition, and complaints are not so numerous nor vigorous as in former years.

While the year has been marked by the installation of but few large power batteries, a number of small and moderate size have been placed in stations throughout the country. Gradually it has been realized that a properly designed battery equipment is a dividend-payer, and regardless of financial considerations, the guarantee of uninterrupted service which such an installation affords makes it in many cases an imperatively demanded auxiliary. The numerous smaller central stations in which the accumulator has hitherto been looked on as an unprofitable and vexatious addition to the existing plant are viewing the question rather differently, with the result that considerable business has been done during the past year in equipments for this class of service.

In train-lighting batteries there has been a marked increase in the number of equipments installed during the past year, and the prospects for a still greater increase during the coming year seem to be favorable.

Altogether the year has been quiet and uneventful from the viewpoint of the battery manufacturer. The business has, however, been considerable, amounting to from eight to ten millions of dollars, according to various estimates and reports.

The Regulation of State Protection for Central Stations.

By Ernest H. Davis, President National Electric Light Association.

THE past year has witnessed a remarkable development in the electric light field, due to decreased cost of generation and distribution, and a wider and increasing use of electricity, especially for power purposes and decorative and sign lighting. The growth of business in the past is certain to be far surpassed in the near future.

Though becoming more and more recognized as a stable industry, the central station still feels the need of a protection against the many, and generally unjust, assaults of the public, the professional politician, and the faddist. And may it not be wise to work toward having the industry so widely regulated by laws that the rights of the public and of the investor will both be properly protected.

Telephony in 1904.

By a Telephone Engineer.

IT IS unfortunate for the purposes of this issue that the annual reports of the telephone companies giving statistics for the year do not appear coincident with the beginning of the new year, but it is within common knowledge that the introduction of instruments has continued to increase and that the telephone is becoming more and more infused into all the dealings of life until this scientific wonder of a few years ago is as commonplace as a door bell.

The operation of the telephone like that of the voice produces a remembrance and not a record, but if there could be any transcription of all of the ten million messages which are conveyed over the system each day what a history of great transactions, of important personal affairs, of matters inherent in the business of individuals, corporations, of firms, and even affairs of nations, have owed their successful transaction to this method of instantaneously cooperating with the voice and obtaining an answer.

As the telephone brings people together through the senses of voice and of hearing without other material relations, so it is that as the mind of one thus comes into direct relation with that of the other without the digressing influence of personality, it is adding to the development of purely ethical principles in the conduct of the affairs in which it serves as the messenger.

The telephone is broadening the scope of business, it is increasing the volume of commercial affairs by the rapidity with which bargains of sale are made and contracts consummated. It is adding to the speed of business transactions and diminishing the cost of interest by its reduction of time between contract and delivery and numerous detailed expenses.

An instance of the amplification of business possibilities through the service of the telephone was forcibly presented during the past year when the active member of a firm of cotton manufacturers stated that he was brought up in the house of a firm that had eleven partners, and this one man stated that he transacted a greater volume of business in the same line of business than his eleven former employers, and in addition to this he managed the affairs of two large textile mills, one about thirty and the other about sixty miles away, from his office.

This man ascribed the whole of his increased commercial capacity to the means afforded by the telephone, not merely in the quickness by which he could communicate his wishes to others, or the facility with which those beyond his presence whether it be in a neighboring building or miles away could address him, but he ascribed it to the fact that each of those communications could be answered at once, and as is the usual case in commercial transactions, there could be the discussion of affairs before the consummation of the purchase or sale.

It goes without saying that a man of such capacity was wise enough to refrain from doing those things which he could hire others to do for him, and that in the various offices of his establishment in the city there were telephones at the desks of all with whom he had occasion to communicate, and there were similar extensive equipments at the mills connected by private lines and also private branch exchanges at the offices and the mills, in order that he should not waste time in the detail of calling up persons over the telephone when a private operator would perform the service much better than he could himself.

In social life it is bringing congenial people together, not merely by the facility which it affords to invitation and appointments, but also by the personal conference carried on in spite of obstructions of storm and impediments of distance.

It is important for all the people who are blessed by the telephone service, and that blessing is becoming almost as universal as the sunshine, that all telephone companies should be sustained upon a sound financial basis, as that is the only means by which quality of service and the extension of plant can be maintained, and it is with great satisfaction, not merely as a business proposition but as a matter of self-preservation, that we have noted that the tendency during the past year has been toward furnishing conditions of adequate rates, for any commercial failure of a telephone company is an impairment of the facilities to every other user of the instruments which are so affected.

The improvement in the telephone service is a matter of general remark, and while it is undoubtedly true that the efforts of telephone companies in training operators to prompt and systematic methods have resulted in quicker and more accurate service, yet it appears that the greater part of the improvement must come from the users of the telephone who are becoming more efficient in their usage of the instrument, avoiding unnecessary words in calling the central, speaking directly into the transmitter clearly, but not vociferously, so that there are no delays required for repeating misunderstood calls, and above all the increasing promptness in answering a summons of the telephone bell.

The amenities of the telephone are well established.

It is "bad form" to use by proxy the advantage of this entrance to the office of a busy man, and when he answers at the telephone ask him to "wait a minute" until the principal for whom the call was made has been summoned to the instrument to begin the conversation.

Some persons do not "wait a minute," but hang up the receiver.

Effusiveness over the telephone is even more out of place than in the presence of those whom one meets.

If the course of the Frenchman who answered the telephone call from a lady by an apology for addressing a lady in his shirt-sleeves was followed as a precedent, it is probable that many telephone conversations during the summer months would be unduly prolonged.

Did you ever think how quick telephone service is in comparison with other transactions?

If one takes watch in hand and notes the three to five seconds for the response of "number," and then a second or two more will cover the time for the mysterious clicks, snaps and gurgles, which denote that the other telephone has been called, and then one must await a greater length for the party to come to the telephone and make response.

Compare this time with that consumed at even the best organized stores by glancing at the watch on opening the door, and again when there is an opportunity to inform the salesperson what goods are wanted. The seconds in the first instance may grow to as many minutes in the second, but there is a great difference in the flight of time to one at a telephone with mind wrapped on the subject of the forthcoming usage of the instrument, and perhaps with the eyes fixed upon the wall at less than normal optic focus, while on the other hand, a customer entering a

store may not know just what is wanted and the senses are tempted with the display of goods to the stimulation of the pocketbook nerve, and time is pleasantly wafted along by the manifestation.

The elevator service in office buildings, which has been developed from the "vertical railway" invented by Otis Tufts a generation ago, has made the skyscrapers possible, and the rental value of property at the quiet of the upper strata at dizzy altitudes above the street greater than that of offices at a traveling distance from the entrance.

Take watch in hand again and count the seconds required until one starts in upward course in an elevator trip.

Still the telephone seconds will be far less than that of elevator service under the best modern conditions with a battery of three to a dozen elevators.

Of the new uses of the telephone during the past year, the most of them have been in the line of mechanical improvements which are the logical result of the work of many people concentrated upon the affairs of the innumerable telephone offices throughout the country, and mention need be made of but one and that is the extensive use of the telephone by Japan in the present war.

The applications of the telephone to the evolution of military service began with that of the United States army in Cuba, which applied the telephone to existing lines and also constructed many military lines during the operations in Cuba.

The Japanese army has amplified those methods into a most perfect system by which military telephone wires follow advance to the outposts and the skirmish lines, where information is at once transmitted to the headquarters of the commanding officer in the field, and thence as occasion may require, communication is in like manner extended to the chief of the army.

In the Philippines the telephone continues to be developed as an adjunct to both the military and official powers in those islands and the reports of the signal service show that its further extension has been urgently solicited by all officers who have had occasion to make or transmit reports on the subject.

Among the developments of telephone service in this country, apart from the logic of numbers of increasing telephones, there is nothing more marked than the widespread application of the private branch exchange, by which the operator connected with a single establishment provides the telephone calls to other cities or even among those of the same concern.

It is said that the number of private branch exchange operators in New York city far exceeds those in the operating rooms of the telephone company, and the same condition of affairs is being rapidly developed in all of the leading cities.

Satisfactory progress has been made in the adaptation of the Pupin loading system to long-distance lines. In Italy a comprehensive series of trials is said to be under way, and in the United States a great amount of quiet work is being undertaken to perfect details in order to make practical use of this important discovery. But little has been heard of wireless telephony, excepting a minor prominence which was given to several systems exhibited at St. Louis during the World's Fair. In the absence of reports to the contrary it may be assumed that the long-distance cables laid between several points in the British Isles and the continent of Europe, and opened to the public about a year ago, are working satisfactorily.

NEW YORK CITY TELEPHONE SERVICE.

SUPERIOR TO ALL EUROPEAN SYSTEMS ACCORDING TO A LONDON TELEPHONE ENGINEER.

The issue of the *St. James' Gazette* of September 6 has a very interesting article by a London telephone engineer comparing the telephone service of New York, London, Paris and Madrid. The author, Mr. Herbert Low Webb, who is a telephone expert in London, has been associated with the operating telephone companies in each of the four cities above mentioned, and, therefore, knows whereof he speaks. This comparison, coming as it does from one who has been connected with each of the companies, can not help but carry weight.

Mr. Webb writes regarding the telephone service in the four cities as follows:

"In February I was in New York; in the intervening time I have been in London, Paris and Madrid, and in each place the most important subject from my point of view has been the telephone service. In the four cities one finds the telephone service operated by private enterprise entirely, by government management entirely, by private enterprise subject to government control, and by a combination or competition—it is difficult to know just how to describe the peculiar telephone arrangements of London—of private enterprise and government management. There enter into the problem too many outside conditions, too many variations of personal equation, for it to be possible to draw any very exact deductions from the very different results attained with the telephone in the four cities above named, but the difference is sufficiently startling and the comparison sufficiently interesting to warrant a discussion of some of the causes of the extreme variation which obtains.

"In old New York city—that is, the boroughs of Manhattan and the Bronx, which constitute what most people know as New York—there were in February last over 120,000 telephones in service. Counting Brooklyn, which is legally a part of New York, although physically as much a distinct city as it was before the incorporation of Greater New York, there were almost 200,000 telephones in use in the whole of New York. Hardly any visitor to the metropolis of America fails to be impressed by the very general use of the telephone service and by its high efficiency.

"In London there are at the present time, between the two systems, approximately 80,000 telephones; that is, London, with three times the population of old New York, has about two-thirds as many telephones, or in proportion to population London has one telephone where New York has five. Yet London has a greater need for a widely developed telephone service than New York, on account of its great area, which would render a highly developed and efficient telephone service a most invaluable facility. London has also fully as great a proportion of well-to-do people as New York, fully as active business interests, and certainly as high a standard of comfort and convenience. The field is here; what is needed is the active and energetic tiller and the removal of the trammels which now exist.

"Paris has at the present time between 30,000 and 40,000 telephones, and every user of those telephones is in a state of rampant indignation at the inefficiency of the service. The system has been operated by the French telegraph department since 1889, when the government forcibly took possession of the property of the then existing telephone company. The system has been allowed to fall behind the times in technical equipment, and has not been developed in proportion to the demands of the public. A very much larger number of subscribers could be obtained in Paris without any difficulty, but a deadlock has long existed because of the unwillingness of the government to spend money on the technical reorganization of the system and on a broad scheme of development to meet the requirements of the public.

"In Madrid, a wealthy city of nearly

600,000 inhabitants, there are now about 2,300 telephones in service. The technical equipment of the system is extremely antiquated, and the service, small as the system is and therefore very easy to conduct, evidently leaves much to be desired. While I was in Madrid I read in a report of the debate in congress of the previous day a vigorous complaint addressed to the government of the inefficiency of the telephone service. The simple fact that the telephone subscribers in Madrid call for each other by name, instead of the number, shows how little the requisites of a telephone service are understood there. Barcelona, which, though a smaller city than Madrid, is of greater commercial activity, has about 3,000 telephones, and this is the largest telephone system in Spain.

"New York shows how to do it; London, Paris and Madrid show how not to do it. The wonderful telephone development in New York has been attained by unrestricted private enterprise. The main features of the telephone business in New York are that there are no government restrictions on the business as a whole, and no municipal opposition to the building of wires. The company operating the New York telephone service has three cardinal points in its policy—the supply of the most efficient service attainable, the charging of rates based exclusively on the individual use of the service, and an active business propaganda for the education of the public in the value of the service. The telephone service in New York is advertised as effectively as any service or commodity of general use to the public. As a result the New York system has increased for several years past at the rate of over 20,000 telephones a year; it has become by far the largest telephone system in the world, and it supplies a service of the very highest efficiency."

Statistics recently given out by the local company operating in the boroughs of Manhattan and the Bronx give 152,714 as the number of telephones under contract and in service in the above boroughs on January 1, 1905. These figures serve to show what a thoroughly efficient and businesslike administration of telephone affairs can accomplish. The American public has been taught to appreciate the immense practical value of telephone service, and although the number of telephones already in service is extremely large, yet there seems to be no decrease in the continued demand for this valuable service.

One feature of the New York telephone service, not mentioned by Mr. Webb, which is greatly appreciated by the New York public, is the fact of its reliability. Not for a moment of the twenty-four hours of any day is the service out of order, except in so far as it is disturbed by an occasional local line trouble, which may be and is promptly corrected. It is this adequate, prompt and courteous service rendered at reasonable rates which has caused the New York telephone system to expand, until it is the admiration of the entire telephone world.

The Faraday Society.

The tenth ordinary meeting of the Faraday Society was held on Monday, December 19, 1904, at the Institution of Electrical Engineers, London, England, Mr. J. Swinburne, vice-president, occupying the chair.

The chairman announced that the council had made the following nominations of officers and members of council to serve during the coming year. The election will take place at the annual general meeting, to be held in February.

President—Lord Kelvin, O. M.

Vice-presidents—Professor A. Crum Brown, F. R. S., Sir W. Huggins, P. R. S., Sir Oliver Lodge, F. R. S., Dr. Ludwig Mond, F. R. S., Lord Rayleigh, O. M., Alex. Siemens, president I. E. E., James Swinburne.

Council—G. T. Beilby, Bertram Blount, W. R. Cooper, Sherard Cowper-Coles, Professor A. K. Huntington, Dr. R. A. Lehfeldt, W. Murray Morrison. Dr. W. S. Squire, Dr. O. J. Steinhart, Professor E. Wilson.

Treasurer—Dr. F. Mollwo Perkin.

M. Adolphe Minet communicated part ii of his paper on "The Electric Furnace: Its Origin, Transformations, and Applications," which was kindly read in abstract by Mr. R. S. Hutton.

In the first and introductory part of his paper, which was read before the society on June 9 last, M. Minet showed that the historical development of the electric furnace falls into the three following periods:

1. Laboratory furnaces, 1808 to 1886.
2. Industrial furnaces, 1886 to 1890.
3. Development of industrial applications from 1890 to the present day.

The present instalment, after some preliminary general remarks on the electromotive force, current densities, and yields, with arc furnaces and resistance furnaces respectively, proceeds to deal in detail with the evolution of the furnace during the first period. The subject is subdivided as follows:

(a) Original furnaces, namely, Davy's arc, Pepys's resistance furnace for the cementation of iron, and Davy's and Napier's cathode furnace.

(b) Electrolysis at high temperatures; the production of aluminum and its alloys and the alkali and alkaline earth metals.

(c) Miscellaneous furnaces, of which the most important are the early Despretz and Pichon furnaces, Berthelot's electric "egg" for the synthesis of acetylene, Siemens's and Huntington's well-known steel and other furnaces, the Louis Clerc furnace, interesting as the progenitor of the famous Moissan type, and Borcher's resistance furnace.

The paper, which is illustrated with diagrams of the principal furnaces alluded to in the text, closes with a bibliography covering the period dealt with. A final instalment will discuss the furnaces of the second and third periods.

Mr. W. B. Clarke referred to the importance and difficulty of making temperature determinations of electric furnace processes, and expressed the hope that M. Minet would deal with that question in part iii of his paper.

Mr. L. Gasta handed round some "siloxicon"—one of the newest products of the electric furnace—and described its properties.

Mr. E. Kilburn Scott (communicated) described some of his experiences in the early days of the manufacture of calcium carbide.

The chairman described a novel type of furnace that he had once hit upon by accident, and which he thought might turn out to be useful. He was sending a current through fused barium chloride, and the temperature having been allowed to get too high the cast-iron crucible melted and formed a fused mass that was kept together by an outer skin of solidified chloride. This suggested the use of a neutral substance like barium chloride for heating to a very high temperature alloys or metals which it was desired not to contaminate with impurities.

Dr. F. Mollwo Perkin read a paper by himself and Mr. W. C. Prebble on the "Electrolytic Analysis of Cobalt and Nickel."

Cobalt—The aim of the experiments was to obtain bright deposits of the metal that should be quantitatively accurate. Various reducing agents were first of all employed, but only with sodium hypophosphite were brilliant deposits obtained, and then phosphorus was found to be present. Salts of the various organic acids were next tried, but only ammonium oxalate and tartrate gave satisfactory results, the latter having the better appearance. Traces of carbon, however, were deposited with the metal. Ammoniacal solutions of ammonium borate were also tried. The most satisfactory results were obtained with a solution containing an alkali phosphate and a little phosphoric acid, the latter to prevent the precipitation of the double sodium cobalt phosphate. To remove a brown anodic deposit which forms, the addition of a

little hydroxylamine is recommended. By this method the whole of the metal can be thrown out in from three to three and one-half hours.

Nickel—Similar solutions were tried for nickel deposition. In this case splendid results were obtained with the borate solution, while the phosphate solution, which gave such good figures in the case of cobalt, was not at all satisfactory.

The authors have not yet succeeded in devising an accurate electrolytic method for the separation of nickel and cobalt, and they find that the methods given in books are unreliable.

Dr. O. J. Steinhart discussed the problem of the separation of the metals. The present method is based on the fact that cobalt is more easily oxidized by chlorine than is nickel. He also referred to the possible industrial bearing of the work of the authors in connection with nickel extraction.

Dr. L. Dobbin, in a written communication, drew attention to the work of Marshall on the same subject. In the case of cobalt he merely added a little nitrate to the ordinary double sulphate solution.

Dr. Perkin said that the presence of nitrate rendered deposition very slow.

Mr. F. Gelstharp presented two short papers entitled "The Electrolytic Preparation of Tin Paste" and "Note on the Electrolytic Recovery of Tin" respectively, which were read by the secretary. An abstract of the first named paper appears elsewhere in this issue.

Mr. W. C. Prebble thought an endless band would be a less crude method of removing the paste than that given by the author. Regarding the presence of arsenic, which was hurtful here, it was curious that in the case of zinc this actually causes a spongy deposit to form.

Dr. O. J. Steinhart gave a few particulars of an electrolytic detinning process that was now successfully treating in London seven or eight thousand tons of scrap per annum. A great difficulty found in practice was to dry the tin sponge without its firing.

Dr. T. C. Cain did not think it probable that sodium was deposited with the tin.

Mr. H. Sayer asked what percentage of the tin was recovered. An objection to an alkali process was that it would not remove the tin from the alloy at the surface-junction of the two metals.

Mr. A. C. Bawtree sent in a written communication describing an electrolytic method for making tin powder that he had worked out some years ago. His solution contained 0.5 per cent $SnCl_2$ and 0.33 per cent $SnCl_4$, and was worked cold with an electromotive force of 2.32 volts. This solution successfully overcame the difficulty of crystalline deposits.

Mr. H. S. Coleman also communicated some of his own experiences in tin deposition. He had worked under conditions similar to those described by Mr. Gelstharp. He found, however, that if the bath were worked between fifty and sixty degrees centigrade no difficulty was experienced in starting the current, and the scrap was stripped clean in twenty minutes.

The Bradford, England, Breakdown.

Further particulars are now given in our English exchanges of the breakdown which occurred at the Bradford (England) municipal station the early part of last December. On the thirteenth of that month a serious short-circuit occurred in the underground mains, throwing the station out of service for practically the entire day. Many of the mains were burned completely in two, and while repairs were going on faults developed at other points of the system.

The mains in use there consisted wholly of single core, until within the past few months. There are no fuses upon these. Various faults have been discovered and remedied during the week following the breakdown, and there has been much difficulty in carrying out this work. The system has been changed a number of times, it being originally a two-wire, 115-volt supply. It was then changed to a two-wire, 230-volt, and then again to a three-wire, 460-volt system. Building maps and records of the underground system have not been kept, and great difficulty is being met in tracing out the various cables and locating their faulty points.

The cause of the trouble is said to have been due to electrolysis, which cut away the lead sheathing. The contributory cause has been the manner in which the joints have been made. The joint boxes were of an old type with rubber glands, and in many cases imperfect contact or none at all was made between the lead sheath and the joint boxes. No special means for preserving the metallic continuity of the sheath was adopted, and corrosion took place at these points, ultimately breaking the cables down and either causing a leak to earth adjacent to the spot, or raising the potential of the sheath and the potential of the core of the cable. This brought about arcing at adjacent points before finding a way to earth. In this manner a fault, once started, led to others. At the time these cables were laid the importance of maintaining a continuous metallic sheath was not recognized. The electrolysis which took place, while being undoubtedly partially due to the local tramway system, may have been assisted by the distributing system itself, since it is impossible to prevent leaks from occurring at different points.

That such a condition of affairs existed in some degree was known to the engineer, and work was going on at the time the breakdown occurred to remove trouble, though the serious condition was not appreciated. One important line which has been examined showed that no provision had been made for preserving the electrical continuity of the sheath, and it is now recommended that all the joints on this line be remade. It is estimated that the carrying out of repairs to the distributing system at Bradford will cost nearly $15,000.

London Tramways.

There are in London, writes United States Consul-General Evans, at London, England, about one hundred and fifteen and one-half miles of tramways, of which eighty-eight miles have been purchased by the London county council under the provisions of the tramway act, 1870, the remainder, about twenty-seven and one-half miles, are still in the hands of various tramway companies, nine in number.

The tramways owned by the council comprise on the north side of the Thames river the undertakings of the North Metropolitan and the London street tramways companies, a total length of forty-eight miles, and on the south side of the Thames the undertakings of the London, the Southeastern Metropolitan and the South London tramways companies, a total length of about forty miles. The tramways owned by the council on the north side of the Thames (forty-eight miles) are leased to the North Metropolitan Tramways Company for a period of fourteen years, expiring in 1910; those on the south side of the Thames (forty miles) are operated by the council itself.

The tramways act of 1870 provides that the local authority concerned may purchase compulsorily, after a period of twenty-one years, from the date of the authorization by Parliament, any tramways constructed and operated by private companies.

A New Tunnel Construction Company in New York City.

The formation and financing of the Hudson Companies, of New York, was announced on January 9. The company has been formed with $21,000,000 capital to take over and eventually operate the tunnels which are now being constructed under the North river, from Hoboken, N. J., to Christopher street, New York city, and the one which is to be built from Exchange Place, Jersey City, to Church and Cortlandt streets, New York city. The new company has purchased the stocks of the construction companies which were formed to build the tunnels, and also that of the New York & New Jersey Railroad Company and the Hudson & Manhattan Railway Company.

It is also announced that the new company has made a contract with the Pennsylvania Railroad Company, by the terms of which the Jersey City terminal of the tunnel from Cortlandt street, New York, under the North river will be beneath the Pennsylvania Railroad station in Jersey City, with a connection to the platform of the station by elevators, and by which the Pennsylvania Railroad will have a ticket office in the Manhattan terminal of the tunnel. The contract with the Pennsylvania Railroad runs for 500 years, and it is stated that similar arrangements have been made with the Erie Railroad, under whose yards the tunnel will run, and also with the Central Railroad of New Jersey at its terminal.

The complete tunnel system of the Hudson Companies will comprise twin tunnels from the terminals of the Central Railroad of New Jersey through Jersey City, with connections at the Pennsylvania and Erie stations, and along the water-front to Hoboken; twin tunnels across the North river from a point between the Erie and Lackawanna stations, connecting with the proposed Jersey City water-front tunnel to Morton street, Manhattan, thence under Christopher street, where one branch will run up Sixth avenue to Thirty-fourth street, and another branch under Ninth street to the connection with the rapid transit tunnel at Fourth avenue, a tunnel from the Pennsylvania station in Jersey City, under the North river and under Cortlandt street, to Church street, thence under Church street to Fulton street and under the river again to the Pennsylvania terminal in Jersey City. It is estimated that the entire work will be completed in two and one-half years.

The National Electric Light Association.

Mr. Henry L. Doherty, as chairman of the committee on membership of the National Electric Light Association, is working hard to increase the membership of the association along the special lines inaugurated at the recent convention. Attractive booklets are being distributed, calling attention to the various classes of membership, and the privileges and benefits to be secured through such membership. Application blanks are also being distributed, making it a comparatively easy matter to secure proper information upon this important subject.

The question box, under the direction of Mr. Homer E. Niesz, as editor, is being enlarged from day to day. A handy form of question blank is being distributed, placing the questions under various headings and asking for suggestions for the betterment of this department.

"Electricity *vs.* Gas" is the title of a pamphlet just issued by the National Electric Light Association for the use of its members who are threatened with Welsbach competition for street lighting. This paper was originally written by Mr. W. F. White for the 1900 meeting of the Ohio Electric Light Association. Mr. White has practically rewritten the paper and has brought it down to date by adding data recently collected from cities and towns all over the country. The pamphlet is illustrated with reproductions from photography showing graphically the difference in street illumination by the two methods. It should prove of great value to the members of the association.

New York Electrical Society's 247th Meeting.

The 247th meeting of the New York Electrical Society will be held in the lecture room of the American Institute, 19 West Forty-fourth street, Wednesday, January 18, at 8 P. M.

Professor W. S. Franklin, of Lehigh University, will lecture on "Electric Waves and the Reaction of Transmission Lines." The elementary physical theory of electric wave motion will be outlined, and the mechanical analogies carefully developed.

The physics of wave distortion and of wave alternation will be popularly discussed and the methods for reducing wave distortion and wave alternation will be clearly and exhaustively explained.

The lecture will be illustrated by lantern slides and by several models, one of which gives a full representation of the distribution of electromotive force and of current along a 200-mile, single-phase, alternating-current, power-transmission line.

The Wire Situation in the Dominion of Canada.

More than 6,000 miles of land telegraphs and sea cables are in operation in the Dominion of Canada. The beginning of the year showed a total of 6,584 miles of completed lines, with 299 offices. The government system consists practically of three blocks. One block connects Quebec with stations at the Atlantic end of the St. Lawrence, with stations eighty miles beyond the Canadian boundary, in Newfoundland, and with stations in Labrador, at Chateau bay, opposite Belle Isle in the Straits of Belle Isle. A cable proceeds southwardly by way of the island of Anticosti and the Magdalen Islands to Cape Breton, with branches in Nova Scotia and New Brunswick. Another block serves the boundary of the great territories of Assiniboia and Saskatchewan. The third block extends from the southern section of the British Columbia north beyond Dawson City in the Yukon, with a branch from the main line to Port Simpson on the Pacific coast below the Alaskan strip of the United States, with a spur to Aberdeen on the coast below Port Simpson.

The wireless telegraph system has been used by the government in connection with its land lines at various points in the Gulf of St. Lawrence and on the Atlantic coast. At Chateau bay, the terminus of the north shore line in Labrador, there is a Marconi station, by means of which communication is maintained with Belle Isle.

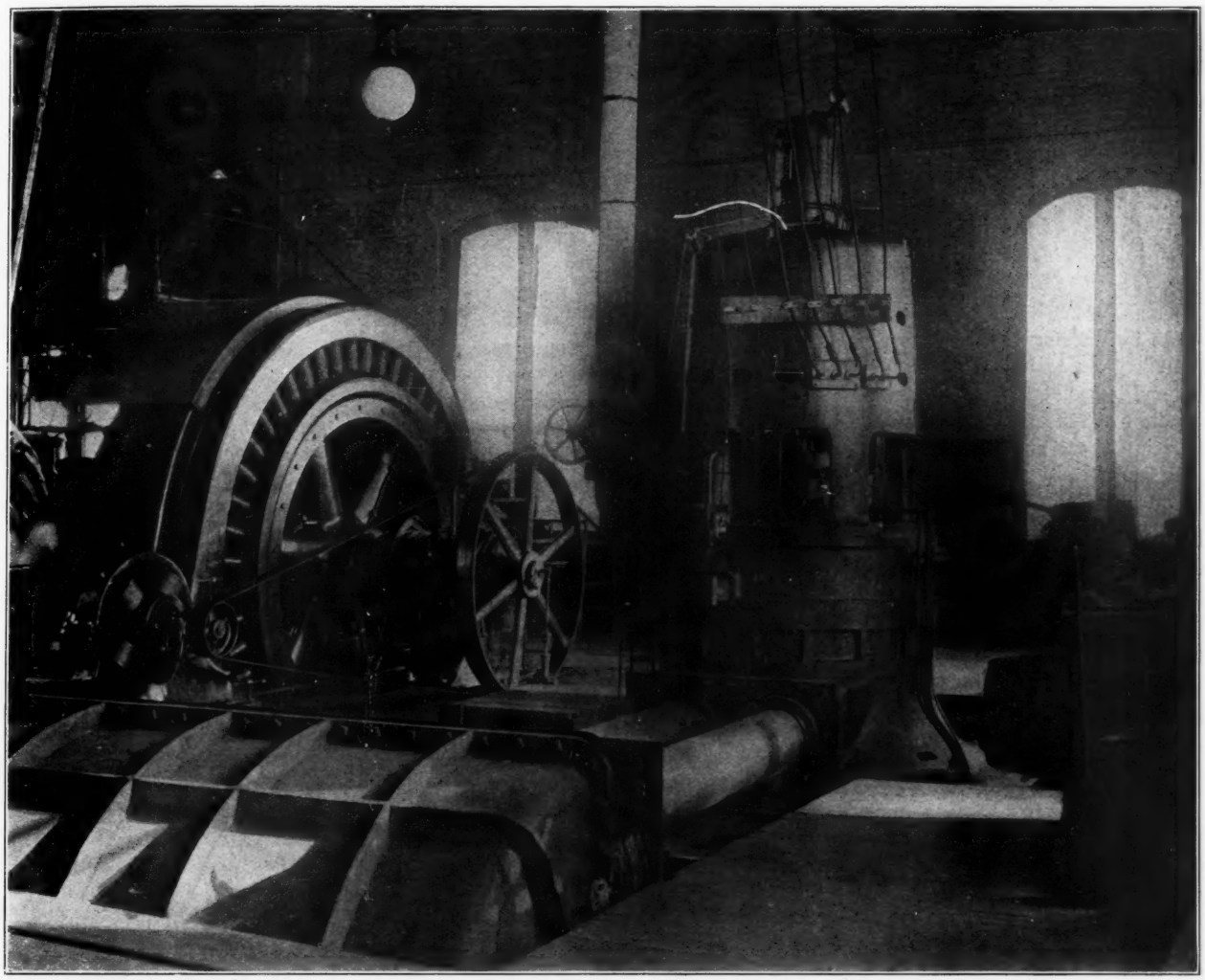
The United Engineering Building

At the meeting of the conference committee on the United Engineering Building, held January 7, Mr. Alfred R. Wolff was unanimously appointed consulting engineer for the heating and ventilation of both the United Engineering Building and the Engineers' Club to be erected at Thirty-ninth and Fortieth streets, under the Carnegie gift to engineering of $1,500,000. Mr. C. O. Mailloux was selected as the consulting electrical engineer for the United Engineering Building, and the firm of Bates & Neilson were selected as consulting electrical engineers for the Engineers' Club. All these gentlemen are well known in connection with the execution of large work of the class named in New York and vicinity, in addition to which they are prominently identified with the organizations that will occupy the buildings in question. Mr. Wolff and Messrs. Bates and Neilson are also members of the Engineers' Club of some years standing, and Mr. Putnam A. Bates was for a long time district engineer for all the Crocker-Wheeler installations in the New York territory.

Electric Supply in the Gate City.

By Alton D. Adams.

OMAHA, the gateway of the Middle West, contains a tenth of the population, and is the market for one-half of all electric supply in Nebraska. In 1900, the federal census gave the state 1,066,300, and Omaha 102,555 persons. As lines from the Omaha plant extend to South Omaha and across the Missouri river to Council Bluffs, Iowa, which are independent cities with populations of 26,001 and 25,802, respectively, the total number of persons within its service area was 154,358, in the census year.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—A PORTION OF THE ENGINE ROOM, SHOWING 500-KILOWATT CURTIS TURBINE.

The entire state of Nebraska, in 1902, contained fifty-four central light and power stations, exclusive of those operated by electric railway companies, and these stations had connected 2,608 arc lamps and 151,162 incandescent lamps, and delivered 12,315,775 kilowatt-hours during the twelve months ending with June 30 of that year. In September, 1904, the Omaha system was operating 1,525 arc lamps and 100,000 incandescent lamps, besides electric motors of 435 horse-power total capacity, and during the twelve months ending August 31 of that year the output amounted to 5,701,098 kilowatt-hours. During this same year the Omaha station consumed 17,304 tons of coal, costing $2.50 per ton, unloaded, and the output was thus 323 kilowatt-hours for each ton of coal burned. In the year ending August 31, 1904, thirty-seven alternating-current series arc lamps, eighty-nine alternating-current multiple arc lamps, and 13,130 incandescent lamps of sixteen nominal candle-power were added to the connected load of the system, and the output in kilowatt-hours was greater by 193,357 during the first six months of 1904 than that in the corresponding period of 1903.

The large and growing load of the Omaha system has been built up with moderate prices and good service, largely on the meter basis. On September 1, 1904, the number of meters in use was 2,909, and the regular rates per kilowatt-hour were fifteen cents for lighting and ten cents for power service. From these rates varying discounts are given according to the amounts of energy consumed per month. For series arc street lamps in Omaha and South Omaha the annual rate is $94.50 per 6.6-ampere enclosed arc, all night and every night, and $69.50 yearly per lamp of equal capacity on the moonlight schedule.

In Omaha and South Omaha the number of 6.6-ampere alternating-current enclosed series arcs is 660, the number of

multiple enclosed alternating-current arcs 600, and the number of sixteen-candle-power incandescent lamps 90,000. Across the river, in Council Bluffs, the 6.6-ampere enclosed series arcs on streets number 165, the commercial enclosed arcs in multiple 100, and the sixteen-candle-power incandescent lamps 10,000. Besides the motor load above mentioned, an equipment of one fifteen-horse-power, three twenty-five-horse-power and one fifty-horse-power, three-phase induction motors has recently been connected to the electric lines for the purpose of operating a grain elevator. Among other loads of heating apparatus is one in a clothing factory where a maximum current of 150 amperes at 106 volts is required for electric smoothing irons. Direct current at the generating station in Omaha is developed at 500 volts for distribution to stationary motors in that city, and at 2,300 volts, sixty cycles, three-phase, for the general supply of both lamps and motors.

In Omaha, the 2,300-volt current is distributed to transformers, both overhead and underground, that feed secondary mains and lamps at 106 volts, and induction motors at 220 volts, three-phase. The 2,300-volt current at the generating station is transformed to 6.6 amperes at a maximum of about 8,000 volts for series arc circuits and also to 5,500 volts for the lines that run to South Omaha and Council Bluffs.

A large part of the distribution circuits in the central portion of Omaha is made up of underground cable laid in 380,000 duct-feet of clay conduit. These conduits with the size, number of conductors, and length of each are as follows:

Length in Feet.	Size of Each Conductor.	Number of Conductors per Cable.
108,607	No. 6 B. & S.	one
32,368	No. 2/0 "	"
370	133,000 C. M.	"
4,507	500,000 "	"
19,575	No. 2/0 B. & S.	two
15,131	250,000 "	"
5,822	No. 2 B. & S.	three
6,204	No. 2/0 "	"
4,507	No. 4/0 "	"

The underground transformers, located in manholes about the central part of Omaha and connected to the low-pressure mains are as follows:

UNDERGROUND TRANSFORMERS.

Capacity Each in Kw.	Number of Each Size.
5	2
7.5	8
20	20
30	5
50	9

These forty-four transformers have a combined capacity of 1,070 kilowatts.

The greater number and capacity of service transformers are overhead, and their sizes are as follows:

Number of Each Size.	Kilowatt Capacity.
78	0.6
82	1
116	1.5
24	2
81	2.5
15	3
40	4
31	5
2	6
41	7.5
8	10
6	15
28	20
1	25
2	50

In South Omaha and Council Bluffs the electric supply is drawn entirely from the 2,300-volt, three-phase lines. The Citizens' Gas and Electric Company distributes the electric energy in Council Bluffs, but control of this corporation passed to the Omaha Electric Light and Power Company in the spring of 1903.

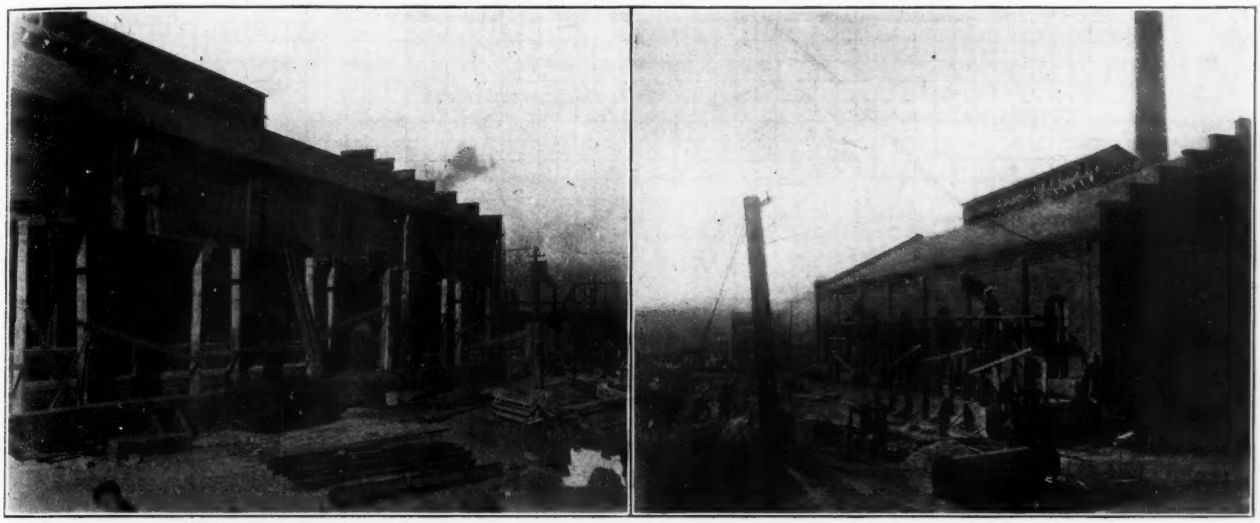
Wherever an induction motor of more than five-horse-power capacity is operated it is connected to a power circuit, and not to one that supplies lamps, and this is true in both Omaha and Council Bluffs. The 5,500-volt, three-phase current in the latter city is received at a one-story substation of twenty-four by thirty-seven feet ground area, and is there transformed to constant current of 6.6 amperes for series arc lamps, 2,300-volt, three-phase current for the general distribution of light and power, and 115 and 230-volt current for use on the three-wire system in the business section of the city. In the substation are two transformers, each rated at 6.6 amperes and 6,000 volts, for arc street lamps, two seventy-five-kilowatt transformers for the 230-volt, three-wire system, two fifty-kilowatt transformers for the 2,300-volt, lighting circuits, and three twenty-five-kilowatt transformers for the 2,300-volt, three-phase motor lines. All of these transformers take primary current at 5,300 volts from the generating station in Omaha. In Council Bluffs, as in South Omaha, the standard pressure on the secondary distributing mains is 115 volts, instead of 106 volts as in Omaha.

The generating plant is housed in a one-story brick building on the bank of the Missouri river, in Omaha, and has railway connection. Tile supported on steel trusses forms the roof of the station, and the floor is concrete on a masonry foundation. Steam for the plant is developed by nine water-tube boilers with a total rated capacity of 3,800 horse-power. Each of four of these boilers is of the Cahall type with a rating of 450 horse-power, and the other five are of the Heine make and rated at 400 horse-power each. All of these boilers are hand-fired save as to the distribution of the coal, which is effected by chain grates. Two stacks are provided for these boilers, one being of brick, 185 feet high and eight feet in internal diameter, and the other of steel, 150 feet high and eighty-six inches in diameter. Steam is developed by these boilers at 160 pounds gauge pressure, but the pressure of one battery, at least, will be raised to 200 pounds for the operation of a steam turbine, a little later. Power for the Omaha system is generated entirely by steam at this station and the reciprocating engines are all of the McIntosh & Seymour make, in the following sizes: one 1,500-horse-power, cross-compound, horizontal engine; one 750-horse-power, tandem-compound, horizontal engine; two 500-horse-power, tandem-compound, horizontal engines. All of these engines operate condensing, and with 160 pounds steam pressure. Steam at the same pressure goes to a Curtis turbine that drives a vertical direct-connected electric generator, made by the General Electric Company. This turbine unit is rated at 500 kilowatts, 2,300 volts, three-phase, but is intended for only temporary use and is to be replaced by a similar unit of 1,500-kilowatt capacity at a later date. It is interesting to note that though this 500-kilowatt turbine unit is supported on six fifteen-inch I-beams that have a span of twenty-one feet there is no trouble from vibration. All of the horizontal electric generators are also of the General

AT WORK ON THE INTAKE, OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY.

Electric make, and they are direct-connected to the several engines as follows: the 1,500-horse-power engine drives a 1,200-kilowatt, 2,300-volt alternator; the 750-horse-power engine is connected to one 500-kilowatt, 2,300-volt alternator, and to a 300-kilowatt, 500-volt, direct-current generator; one of the 500-horse-power engines drives only a 300-kilowatt, 2,300-volt alternator, and the other engine is connected to an alternator of this capacity and also to a 300-kilowatt, 500-volt, direct-current generator. Allowing 750 horse-power for the steam turbine, the combined rating of all the above-named engines amounts to 4,000 horse-power. The electric generators have a combined rating of 2,900 kilowatts. All of the alternators, save that connected to the steam turbine, were formerly of the monocycle type, but they have been, or shortly will be, changed to the three-phase winding. A 500-kilowatt, 500-volt rotary converter has been ordered, and is to be located in the generating station to carry the load of direct-current motors, and thus displace the direct-current generators. For the series circuits of arc street lamps the station contains seven General Electric transformers with a capacity of 6.6 amperes and 8,000 volts each.

Two transformers of 150 kilowatts each, and four of seventy-five kilowatts each, are used to step the station voltage of 2,300 up to 5,500 for the transmissions to South Omaha and Council Bluffs, and another transformer of 150-kilowatt capacity is to be added for the same purpose. Along one side of the station is the switchboard with the operating gallery some feet above the generator floor. Besides the operating switches and indicating instruments this board carries a set of recording wattmeters for the station output.



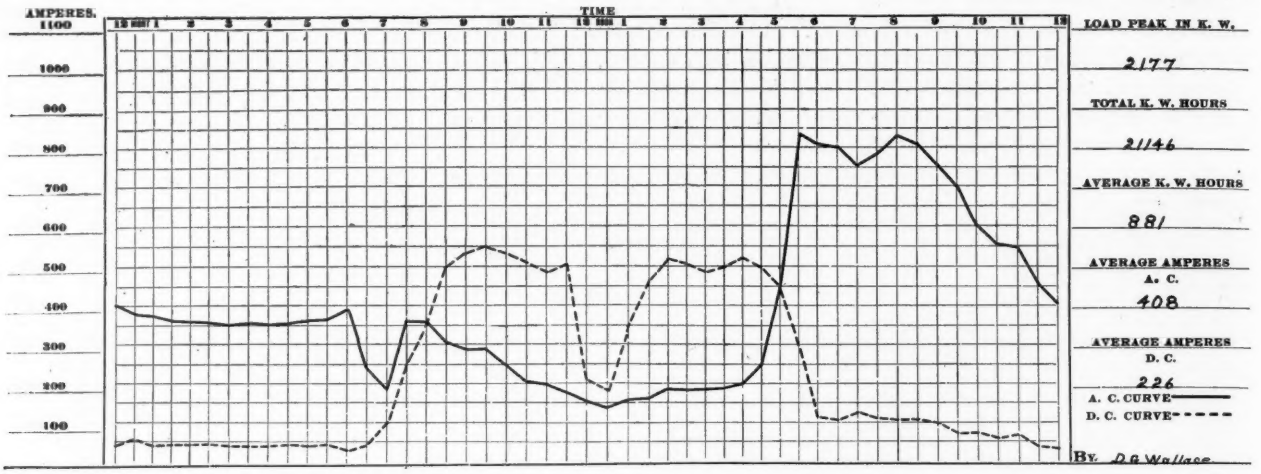
OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—EXTENSION OF STATION FOR NEW SWITCHBOARD.

Water for the engine condensers is taken from the Missouri river, and for this purpose an intake has been built some distance out into the stream. An iron suction pipe connects the intake with the pump and condensers. On the face of the intake is a rack composed of one and one-quarter-inch by one-quarter-inch iron bars, and behind these there are two screens with five-eighths-inch mesh, formed with No. 11 steel wire.

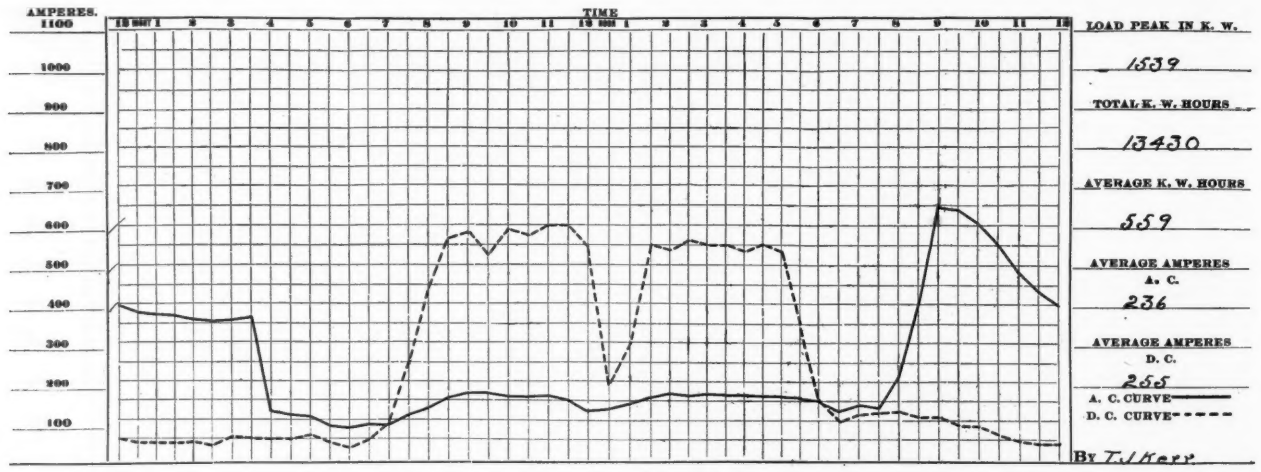
Three curves presented herewith illus-

OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—AT WORK ON THE INTAKE.

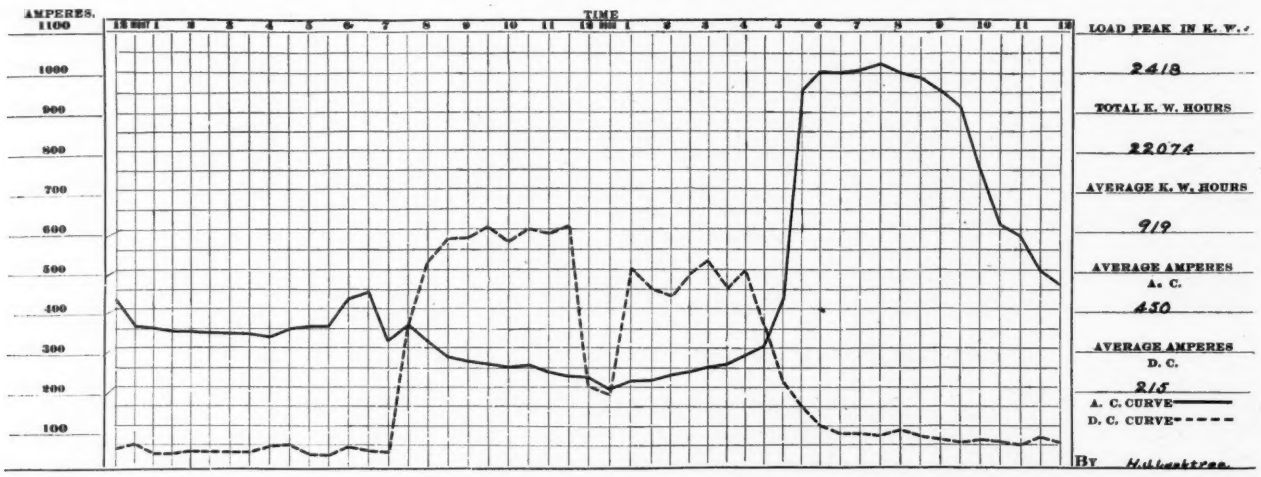
trate the character of the load on the Omaha electric system, and also its growth during eleven months. The earliest curve, that of December 22, 1903, has a peak load of 2,177 kilowatts occurring at 5.30 P. M., on the December day. For this day the total output was 21,146 kilowatt-hours, with an average of 881 kilowatt-hours, so that the average load was forty-one per cent of the maximum. Most of the supply to motors was carried out with direct current at 500 volts, and its average amperes for the twenty-four hours were 226. The average amperes of the three-phase load at 2,300 volts were 408, or nearly double the average of direct-current amperes, so that the alternating current was more than eight times the direct-current output of energy.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN DECEMBER 22, 1903.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN JUNE 22, 1904.



OMAHA, NEB., ELECTRIC LIGHT AND POWER COMPANY—LOAD RECORD TAKEN NOVEMBER 26, 1904.

Six months later, on June 22, 1904, the peak load was down to 1,539 kilowatts

and was made up mostly of lamps, at 9 P. M. The average load was 559 kilowatts, corresponding to the total output of 13,430 kilowatt-hours for the day. For the direct-current motors the maximum load was 600 amperes, or fifty amperes more than that of the previous December, and the average direct-current load for the twenty-four hours was 255 amperes, or forty-two per cent of the maximum. With the combined load of lamps and motors the average amounted to only thirty-six per cent of the peak. As the average alternating current was 236 amperes at about 2,300 volts, while the average direct-current amperes were 255 at 500 volts, the energy output for the twenty-four hours was about four times as great on the three-phase as on the purely power service, in contrast with a corresponding ratio of eight to one in favor of the three-phase current during the previous December day.

Eleven months after the record of the former of the above-named curves was made, on November 26, 1904, the peak load on the Omaha system reached 2,418 kilowatts, an increase of eleven per cent, in spite of the fact that lighting demands are not as heavy in November as in December. For this November day the total output was 22,074 kilowatt-hours, and the average load 919 kilowatts, a lead of about five per cent over the previous December. On the three-phase generators the average amperes were 450 for the day, and on the 500-volt motor lines the average was 215 amperes, so that the alternating was nearly ten times the direct-current output of energy. This gain of the three-phase in comparison with the direct-current load seems due to the gradual adoption of induction motors.

At the generating station of this interesting system the tendency is toward a single type of main generators, direct-coupled to horizontal reciprocating engines, or vertical steam turbines. For loads beyond the easy reach of 2,300-volt, three-phase lines, the plan is to provide substations that receive current at 5,300 or some higher voltage, and transform it for constant pressure and for series lines. Direct-current distribution is already confined to 500-volt motor service in the business portion of Omaha, and large, new motors in the future will be mainly of the induction type. Underground cables are doing a rapidly increasing share of the work of distribution, and there is a marked tendency to carry the central part of the lighting load on low-pressure underground mains fed by comparatively large transformers in manholes.

So satisfactory are the service and prices of the electric system at Omaha, that a proposition to establish a municipal plant was defeated by a large majority at a recent city election.

The foregoing facts have been obtained through the kindness of Mr. H. A. Holdrege, general manager of the Omaha Electric Light and Power Company.

Automobile Shows in New York.

Two automobile shows will be held in the city of New York during the coming week—that of the Importers' Automobile Salon, which is being held in Herald Square Exhibition Hall, on the top floor of the Macy Building, from January 11 to 24; and the fifth annual automobile show, which is being held at Madison Square Garden from January 14 to 21, under the auspices of the Automobile Club of America and the National Association of Automobile Manufacturers, Incorporated.

The Importers' Salon is given up to the exhibits of foreign manufacturers. In decorating the hall the plan has been followed of decorating it as a whole. The general color scheme is green. The columns and cornices are draped with American and foreign flags and wound with evergreens crowned with circles of colored electric lights, about 3,000 lights being used altogether for this purpose.

About 250 motor-car and accessory manufacturers have taken space in the exhibition at Madison Square Garden. The demand for space was greater than ever before, and enough applications were received to fill a building three times the size of Madison Square Garden.

A number of dinners and meetings will be held in connection with the show. On Sunday evening, January 15, will be held the E. E. Schwartzkopf breakfast, at the Café des Beaux Arts. On Sunday evening the New York Motor Club will have a dinner at the Hotel Astor. On Monday, January 16, will be held the annual banquet of the American Automobile Association, at the Waldorf-Astoria. The National Association of Automobile Manufacturers will hold a smoker and vaudeville entertainment on Friday evening, January 20, and the Automobile Club of America will hold a dinner at the Waldorf-Astoria on Saturday, January 21. The American Automobile Association will hold its annual meeting at the Hotel Seville, Monday, January 16.

Among the exhibitors are the White Sewing Machine Company, Cleveland, Ohio; Pope Manufacturing Company, New York city; Olds Motor Works, Detroit, Mich.; Baker Motor Vehicle Company, Cleveland, Ohio; the George N. Pierce Company, Buffalo, N. Y.; Thomas B. Jeffrey & Company, Kenosha, Wis.; Electric Vehicle Company, Hartford, Ct.; Northern Manufacturing Company, Detroit, Mich.; E. R. Thomas Motor Company, Buffalo, N. Y.; Daimler Manufacturing Company, Long Island City, N. Y.; Vehicle Equipment Company, New York city; National Motor Vehicle Company, Indianapolis, Ind.; Studebaker Automobile Company, South Bend, Ind.; H. H. Franklin Manufacturing Company, Syracuse, N. Y.; Diamond Rubber Company, New York city; R. E. Dietz Company, New York city; the Goodyear Tire and Rubber Company, Akron, Ohio; C. F. Splitdorf, New York city; the Veeder Manufacturing Company, Hartford, Ct.; American Roller Bearing Company, South Framingham, Mass.; Weston-Mott Company, Utica, N. Y.; National Carbon Company, Cleveland, Ohio; American Coil Company, West Somerville, Mass.; Dow Portable Electric Company, Braintree, Mass.; the Standard Welding Company, Cleveland, Ohio; Dayton Electrical Manufacturing Company, Dayton, Ohio; Automobile Supply Company, New York city; Rushmore Dynamo Works, Plainfield, N. J.; Lunkenheimer Company, New York city; Electric Contract Company, New York city; United Electrical Manufacturing Company, New York city; Charles H. Metz, Waltham, Mass.; Edison Storage Battery Company, Glen Ridge, N. J.; William Roche, New York city; Charles E. Miller, New York city; New York Edison Company, New York city; Warner Instrument Company, Beloit, Wis.; Brown & Sharpe Manufacturing Company, Providence, R. I.; Polyphase Ignition System Company, New York city; Constant Dynamo Company, Boston, Mass.; Meyrowitz Manufacturing Company, New York city; American Electrical Novelty and Manufacturing Company, New York city.

Texas Telephones.

TO THE EDITOR OF THE ELECTRICAL REVIEW:

In your issue of December 31 the statement appears that the Cuyahoga Telephone Company has established two street telephones on lampposts on Euclid avenue in the city of Cleveland, and that but one other city in the United States, namely, Bridgeport, Ct., shares the distinction with Cleveland of having devices of this character placed at the disposal of the public. I beg to say that several of these street telephones were placed in Dallas by the Southwestern Telegraph and Telephone Company quite a year ago, and they have been in successful operation ever since.

I might also remark, incidentally, that if there is anything in the way of up-to-date telephone equipment that Dallas is without we are not aware of it, which is true, likewise, of most other things that contribute to the making of a live hustling, wide-awake, largest small city in the United States.

FRANK B. KNIGHT.

Dallas, Tex., January 5.

Reviews of Current Engineering and Scientific Literature.

Calcium Metal.

Electrometallurgy has at last succeeded in producing metallic calcium in commercial quantities, and the method is here described by Mr. R. H. Hutton. Until a short time ago this metal had been available in small amounts only and remained a rare laboratory specimen. It is now obtainable at a price per kilogramme less than that charged by most chemical dealers for a small one-gramme sample. This metal was first formed by Davy, who made an amalgam by electrolyzing lime mixed with mercuric oxide, slightly moistened with a mercury cathode. He isolated the metal in small quantities by distilling off the mercury. Matthiesen, making use of Bunsen's suggestion of applying high current-density at the cathode, succeeded in obtaining a few grammes at a time by electrolyzing fused chloride or mixtures of calcium and other chlorides having a lower fusing point. Moissan found that molten sodium forms an excellent solvent for calcium, and by heating calcium iodide with a large excess of sodium, obtained on cooling a cake of sodium calcium alloy resting on the sodium iodide. Treating small quantities of the alloy with absolute alkali, a fine crystalline powder consisting of pure calcium was obtained. By pressure and fusion this powder was agglomerated, and fine specimens of calcium were exhibited at the Paris Exposition in 1900. To Moissan largely is due our present knowledge of the properties of the pure metal. Borchers and Stockem and Ruff and Plato employed a principle similar to that of Matthiesen, but succeeded in obtaining better yields of calcium. The latest developments have been brought about by Suter and Redlich, who, by employing a cathode which only just touched the surface of the fused calcium chloride, obtained a small layer of fused calcium under the cathode. Before the calcium has collected in sufficient amount to flow away, the electrode is very slightly raised. The metal comes into a cooler zone and solidifies. By continuing the process a rather irregular rod of calcium is built up, which itself forms the cathode. The metal is supplied in these rough rods, which in outward appearance resemble cabbage stalks, but show a white metallic surface when cut through. The present price quoted in Germany is $5 a kilogramme retail, or $3 a kilogramme in 100-kilogramme lots. The product is said to contain over ninety-seven per cent of pure calcium, the impurities being chiefly calcium chloride and sodium. There may not be a large demand for the metal.—*Abstracted from Nature (London), December 22.*

Electrical Conductivity of Very Dilute Hydrochloric and Nitric Acid Solutions.

It is very difficult to obtain an exact value for the equivalent conductivity of completely dissociated acids, owing to the large effect of the impurities of the water on the conductivity of even strong acids in very dilute solutions. These effects give rise to a maximum value of the conductivity at a dilution of from 500 to 2,000 litres, but to a marked decrease in its value at greater dilutions. A knowledge of the theoretical limiting value is of importance, since upon it is based the assumed value of the equivalent conductivity of the hydrogen ion and the calculated decrease of dissociation of acids in general. In 1898 Kohlrausch derived values for the conductivity of strong acids at extreme dilution, by adding to the observed value at 0.001 normal a quantity equal to the product of the observed increase between this dilution and 0.0001 normal in the case of neutral salts, by the ratio of the increase between 0.1 and 0.001 normal in the case of the acids, the corresponding increase in the case of neutral salts, the conductivity of the latter having been first subtracted in all cases. In the present article Messrs. H. M. Goodwin and R. Haskell have endeavored to devise a method which would eliminate, to a great extent, the effect of the impurities in the water, by appropriate measurements of the conductivity of dilute acids. The solution was prepared with extreme care, and a special arrangement of cell adopted, in which the measurements were made. The method of correction involved the principle that the total effect of the acid and of the impurities in the water on the conductivity of each other is already produced when a relatively small quantity of acid has been added to the water, after which further additions of acid remain unaffected by the impurities. The results of the measurements give evidence of the correctness of this principle. Two methods were employed. The values for zero concentration or infinite dilution were found by extrapolation from those for 0.00025 normal, under the assumption that the change between these two limits of concentration stands in the same ratio to that between 0.00025 and 0.01 normal as in the case of neutral salts. The values found were less than one per cent lower than those of Kohlrausch, and are believed to be substantially correct.—*Abstracted from the Physical Review (Lancaster, Pa.), December.*

Electromechanical Compounding of Generating Sets.

An electromechanical method of regulating steam-driven generators has been devised by M. J. L. Routin, and is here described by M. De Kermond. The usual method of governing generating units is to maintain the speed of the engine as nearly constant as possible, and then, by means of compounding or other regulating device, to hold the voltage of the generator constant. Routin takes advantage of the condition, that a given load upon a generator calls for a definite valve opening if constant speed is to be maintained, and this load also requires a definite excitation of the generator if the voltage is to be constant. It is therefore possible to combine the engine governor with the generator regulating device, and thus control both machines at the same time. The method of doing this for a direct-current generator consists in exciting this in shunt, the excitation being varied by means of a field rheostat. This field rheostat is controlled by a small motor, which is itself supplied by an auxiliary generator. The auxiliary generator is coupled to the generator shaft so as to be driven at the same speed. It is excited by means of two windings, the one a series winding through which the generator load passes; the other a shunt winding which acts in opposition to the series winding, and the current which passes through this shunt winding is controlled by the small motor just mentioned. The field of this latter motor is in shunt with the system. This little motor, besides regulating the shunt circuit of the auxiliary generator, drives, through a worm wheel, a mechanism which varies the field resistance of the main generator. To this same mechanism is attached a speed governor driven by the engine itself. The action is as follows: the series and shunt windings of the auxiliary generator being in opposition, and there being no load on the generator, the small motor will shift the regulating rheostat of the auxiliary generator until there is no current

passing through the latter's shunt coil. There then being no excitation, there will be no current passing through the armature of the motor, and it will cease to turn. But while this machine has been turning it has been introducing resistance into the main generator's field, bringing the voltage to normal. When any load is thrown on the system, current passes through the series winding of the auxiliary generator, excites its field, and thus sends a current through the governing motor, causing this to turn. This decreases the resistance in the main generator field, and, at the same time, causes the current to pass through the shunt winding of the auxiliary generator. When this winding just balances the series winding, the small motor will cease to turn, and this will occur if the system is in proper adjustment when the voltage of the system has been brought up to normal. While this adjustment has been going on, the tension on the governor spring has been changed through the attachment previously mentioned, and the speed of the engine brought back to normal. In addition to these devices there is an electromagnet whose coil is connected across the generator terminals, and the pull of which acts against the governor springs. This arrangement not only provides for changes in load on the supply system, but also takes care of any change in steam pressure. To apply this method of control to an alternating-current system, it is only necessary to convert the alternating current which is sent through the various windings into a proportional direct current. It will then regulate the system, maintain the voltage constant independent of changes in load, changes in power-factor and changes in steam pressure, keeping both voltage and frequency constant.—*Translated and abstracted from L'Électricien (Paris), December* 24.

Water Power and Steam Power in the British Isles.

The water power of England is small, amounting to not more than 10,000 horse-power, while the total development in all countries is between 1,500,000 and 2,000,000. This want of enterprise Mr. E. Ristori believes is due to two causes: first, the reluctance of the English people to take up the new ideas quickly, and, second, to a prevailing notion that practically no water power exists in the British Isles, and that what there is is unsuitable for commercial development, the more so as coal in England is so cheap that there is no advantage in using water power instead of steam. This last assertion, the author holds, is wrong, and he endeavors to prove his case in this article. Wherever there is a combination of a large water-shed near such geographical formation of the ground as affords a suitable site for a reservoir, and a considerable difference of level within a short distance of the storage, water power may be developed. On the west coast of Scotland, in Wales and in the west of Ireland there are a great many places where these conditions can be found and where water power can be developed just as cheaply as in many places abroad. The climatic conditions in these districts are very favorable to water power, because the rainfall is large and uniform. In these districts there will be needed storage for only 100 days, whereas in other countries it must be provided for 150 or even 200 days. Moreover, winters are mild and there is no danger of low water during the cold season. In comparing a proposed water-power plant with a steam plant it should be borne in mind that the latter requires many auxiliary appliances not necessary for the former, all of which involve a large capital expenditure and require heavy maintenance. A steam plant requires more ground and a larger building to house the machinery than does a hydraulic plant. As regards cost of the installation, the electrical portion of the plant in any generating station is independent of the motive power used, but, if anything, the plant required for a steam-generating station is more expensive than that for a water power, because the former requires a system of large and small units to enable operation to be carried on efficiently at light loads. In the case of the water power, only large units are used, as the loss at light loads is represented by a little waste of water. As regards the other portions of the capital expenditure required in the case of water power, these are represented by the dam, the water carrier (this may be a canal or pipe line), the pipes conveying the water under pressure to the power station, and the set of turbines. Turbines for low falls are comparatively more costly than those for high falls, but the pipe line, being shorter, costs less. In any case, the total of these two items may be taken at from ten dollars to fifteen dollars per horse-power installed in the case of fairly large installations. The cost of the dam and the conduit is independent of the amount of power. Examining several hydraulic installations, it is found that the cost varied from thirty dollars to seventy dollars per horse-power for them. If the load-factor is low, the cost per horse-power installed will be even less. It is difficult to obtain a close figure for the cost of dams and canals, but the author estimates that the total cost of the hydraulic works of any good power scheme, including the turbines, should not exceed $100 per horse-power. It is said that there are some instances where this cost fell as low as fifty dollars per horse-power. The bulk of this expenditure is represented by dams, conduits and pipes, which in practice do not depreciate at all. The only depreciation takes place in the turbines, which represent only from $2.50 to $5 per horse-power. It is therefore allowable to take the depreciation of such a plant at not more than one per cent per annum. Adding the interest, the annual cost represented by these two items will not be less than three dollars nor more than six dollars per horse-power. A corresponding figure for steam is obtained on the assumption that the cost of the steam appliances, exclusive of the generator, will be not less than sixty dollars—probably nearer eighty dollars—per horse-power. Depreciation on this plant will be between $7.50 and $11 per horse-power per year. To obtain the figure for the working cost of steam plants, the records of the British Board of Trade are consulted, and a rate of 0.7 cent per kilowatt-hour is obtained for an economical steam plant (for such only need be considered). Assuming a twenty-five per cent load-factor, it is found that the running cost of such a plant amounts to $11.90 per horse-power-year (not including the labor item), but this is all saved in a water-power plant. Adding this figure to that obtained above for the interest, maintenance and depreciation, it is found that the annual cost per horse-power-year for a steam plant with a twenty-five per cent load-factor is $19.40. For a water-power plant the annual cost will not exceed $8.50 per horse-power-year. The conclusion is therefore reached that, under the conditions assumed, water power would cost at least ten dollars less per horse-power-year than steam.—*Abstracted from Engineering (London), December* 23.

Electrical Business in Chicago in 1904.

The business of Chicago, Ill., in electrical apparatus during 1904 is given as follows: manufactures, 1904, $15,000,000; manufactures, 1903, $16,000,000; decrease, six per cent. Sales, 1904, $13,000,000; sales, 1903, $13,000,000.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Demonstration of Electric Heating and Cooking Apparatus at R. H. Macy & Company.

The accompanying illustration shows a handsome iron booth erected by the firm of R. H. Macy & Company, in the house-

ELECTRIC HEATING AND COOKING APPARATUS.

furnishing department of their large department store at Herald Square, New York city. In this booth there is being demonstrated the electric heating and cooking apparatus made by the Prometheus Electric Company, of New York city, a full line of which is displayed at the various counters, as shown.

An expert demonstrator prepares throughout the day delicious dishes which are dispensed to the public, using at different times food-heaters, chafing-dishes, stoves and oven, and also showing the use of the laundry-irons.

This is probably the first time that a large department store has shown the actual use of electric cooking apparatus directly to the public, and the manner in which the latter have purchased this material proves conclusively that this manner of educating the public to the use of these up-to-date utensils is a correct one.

At the other end of the booth other electrical apparatus are sold and the entire display makes a very attractive and instructive exhibit.

Marshall Sockets.

The Marshall Electric Manufacturing Company, 301 Congress street, Boston, Mass., reports a very active market for its sockets. These sockets are made in very large quantities by patented automatic machinery. The process of manufacture ensures a uniform product and this is largely the reason for the popularity of the material.

The Warner Arc Lamp.

The Warner arc lamp and the Warner multiple series system for direct-current series circuits, manufactured by the Warner Arc Lamp Company, Muncie, Ind., are meeting with substantial success in all parts of the country. This system is not a laboratory experiment, as the designer is now and has been for over fifteen years actively engaged in the electric lighting business. He is in a position to understand the needs and requirements of central-station practice and the lighting public.

The Warner lamp is a shunt-controlled lamp, but no effort has been made to feed the carbons down gradually, not even a dashpot being used to complicate the mechanism. The Warner lamp, because of its positive action in bringing the carbons together with considerable force each time they are fed down, keeps any mushroom formation from taking place at the carbons.

The Warner multiple series system is simply the application of the regular Warner multiple lamp to a 9.6-ampere series circuit, the lamps being wired in multiples of two throughout the entire circuit, with a Warner branch box to each pair of lamps. The function of this branch box is threefold: (1) to properly divide the current, giving each lamp an equal amount; (2) in case a lamp becomes inoperative through the carbons burning out or open circuit, or from any other cause whatever the branch box automatically throws all the current through the remaining lamp and feeds the carbons at the proper time; (3) should both lamps become inoperative from any cause (open circuit or otherwise), the branch box closes the circuit and automatically shunts the current around the two disabled lamps, without affecting the operation of the remaining lamps in the circuit.

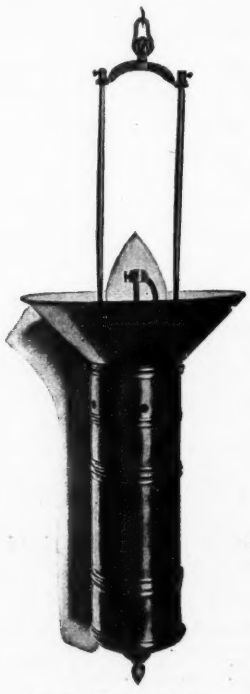
A plain series circuit may be changed over to the new system gradually, hanging in a pair of lamps and a branch box here and there, at any convenient point. In fact, the circuit can be part plain series and the rest multiple system, and the standard 9.6-ampere series enclosed arc lamp may be used for the part of the circuit left plain series.

A Constant-Potential Inverted Arc Lamp.

The C. J. Toerring Company, of Philadelphia, Pa., has recently placed on the market a constant-potential direct-current inverted arc lamp. In designing this lamp the following three conditions were held to be ideal for artificial illumination:

1. The light intensity should be sufficient to render all objects clearly visible without fatigue to the eye, and be so well distributed and diffused that no perceptible shadows could be cast by moving or stationary objects of ordinary size.

2. The visible source of light should not itself be perceptibly brighter than objects illuminated by it.



INVERTED ARC LAMP.

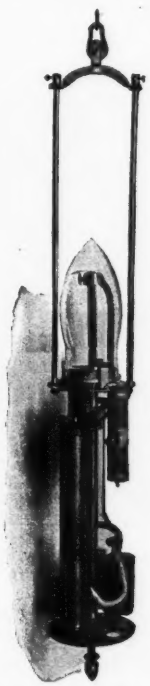
3. The color of the light should approximate that of sunlight in order to give true color values.

These conditions have been fairly well met by this inverted arc lighting system.

The two illustrations show the design of a constant-potential direct-current inverted arc lamp.

With the direct-current arc, eighty-five per cent of the total light comes from the crater of the positive carbon, five per cent from the incandescent vapor of the arc proper, and ten per cent from the negative crater.

In order to approximate the first condition it was considered expedient to throw the intense crater light upward against the ceiling if suitable or against a ceiling



INVERTED ARC LAMP WITH CASE REMOVED.

reflector. To do this economically with a direct-current arc it was necessary to place the positive carbon below the negative, which allows eighty-five per cent of the light to be thrown on the ceiling reflector without loss by reflection. The ceiling reflector then becomes the secondary source of illumination. When the light reaches the ceiling reflector it is spread over a relatively large area, its intensity being correspondingly lessened. From here the light is reflected to the floor with no greater loss than when passed through the usual alabaster globes, and is better diffused.

To satisfy the second condition the arc-enclosing globe is surrounded by a metal reflector which absolutely prevents any light from the arc and arc-enclosing globe to penetrate directly to the eyes of persons on the floor. If it were allowed to do so it would tend to contract the pupil of the eye and thereby render it much less sensitive to the light reflected from the objects in the room.

The third condition is most effectively obtained with the light from the 110-volt enclosed arc lamp. For 220-volt circuits two 110-volt lamps are placed in series, the operating mechanism being changed to suit this condition.

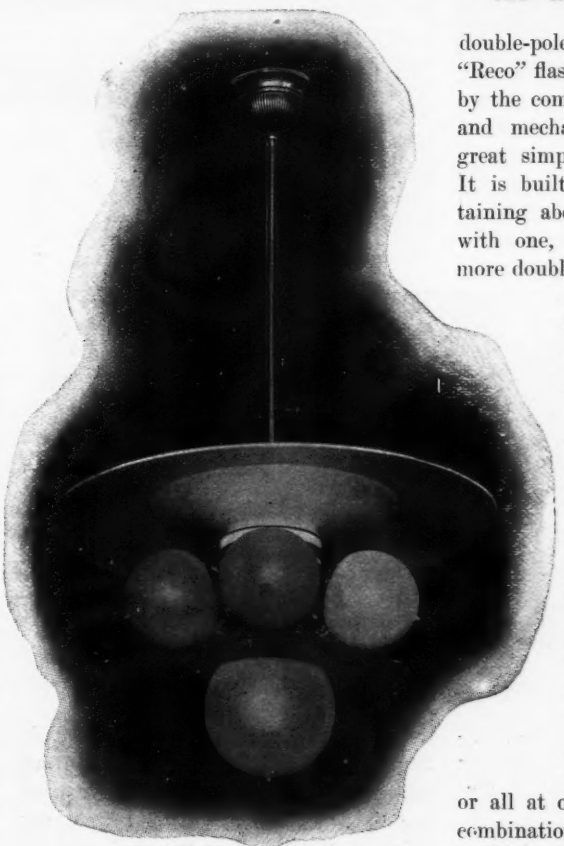
The design and construction of the lamps is of the usual Toerring standard. Before placing the lamps on the market several lamps were put into the hands of competent engineers who operated them for nine months without developing the least fault.

When several lamps were placed in a draughting room the diffusion of the light was found to be so perfect that when a pencil was placed in a vertical position on a drawing-board the shadows cast were almost imperceptible.

The lamps are especially suited to the lighting of textile and silk mills, draughting rooms, large commercial offices and wherever light with a minimum of shadow and no glare is wanted.

A New Form of "Arc-Burst."

The accompanying illustration shows the new form of "arc-burst" placed upon the market by the Benjamin Electric Manufacturing Company, Chicago, Ill.

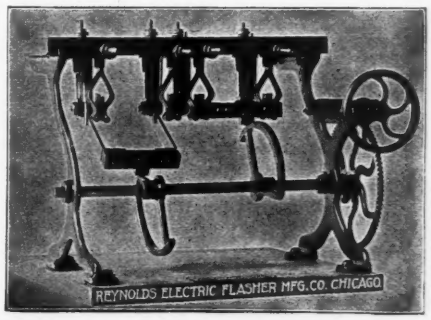


BENJAMIN "ARC-BURST."

This "arc-burst" is constructed from a Benjamin wireless cluster. It is adapted to art galleries, restaurants, stores and public buildings, and consists of a Benjamin cluster with a three-foot stem, a crow's foot, canopy, shades, shade-holders and lamps. The standard finish of the fixture is polished brass. Other finishes may be furnished if desired. The fixture is furnished in three standard sizes: four-light, 130 candle-power, 270 watts; five-light, 155 candle-power, 320 watts; six-light, 180 candle-power, 370 watts.

The "Reco" Electric Sign Flasher.

The Reynolds Electric Flasher Manufacturing Company, 221 Fifth avenue, Chicago, Ill., has placed on the market a new form of electric sign flasher with



THE "RECO" ELECTRIC SIGN FLASHER.

double-pole switches, designated as the "Reco" flasher. This apparatus is claimed by the company to be perfect electrically and mechanically, and is possessed of great simplicity, and operates perfectly. It is built for controlling circuits containing above six amperes, and is made with one, two, three, four, five, six or more double-pole switches. These switches have a capacity of 20, 35, 50, 75 or 100 amperes each. Thus, from 50 to 500 four-candle-power lamps may be flashed on and off with one switch, and as many switches may be added as desired. The switches are controlled by cams, which close them automatically in any desired manner, producing any combination or flashing effect. With this flasher electric signs may be flashed as a whole; double-face signs flashed alternately, each side as a whole; signs containing a number of words or lines, each word or line flashed separately or all at once. In fact, any number of combinations can be secured.

The mechanical and electrical construction is simple, heavy and substantial. The construction avoids a multiplicity of circuits running through the flasher, as the division of circuits can be made at a

cutout box located in the circuit between the sign and the flasher.

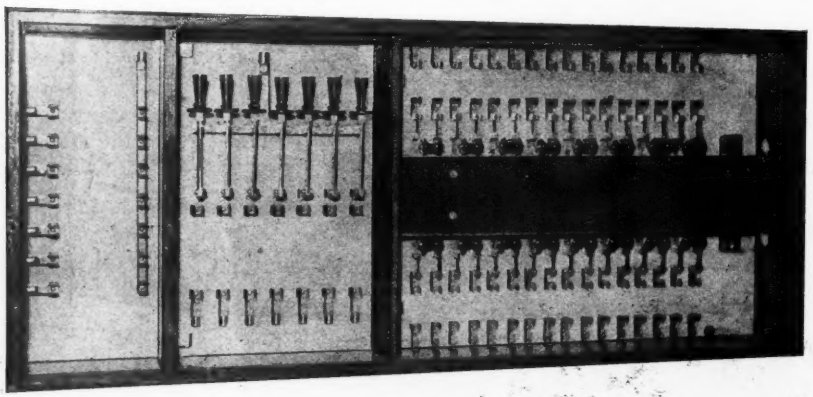
The switch jaws are provided with self-lubricators in the shape of grease-cups or pockets, which hold sufficient grease to keep the sliding contacts perfectly clean and well lubricated for weeks without refilling. These may be observed in the accompanying illustration.

The switch blades drop from the jaws by gravity action as soon as they are released by the cams, thus ensuring an instantaneous break and avoiding undue arcing.

These flashers are simple to connect, and require but one lead from each side of the sign and one return wire, or one positive and one negative from each word or line, and two or three mains from the service, according to the system. In other words, these flashers are simply cut in between the sign and the service, and can be quickly connected to signs already installed.

Subway Station Panels.

The accompanying illustration shows a typical panel-board built by Waterbury & Company, 69 South street, New York city, for the Interborough Rapid Transit Company, for installation in the subway stations of the latter company's underground railway system. These panels are built according to the specifications drawn up by W. Parks, of the Interborough company, and C. W. Cornell, of the Tucker Electrical Construction Company. All of the panels installed in the subway



Subway Station Light and Power Panel.

stations are similar and control the lighting circuit as well as the circuit for driving small motors in the station for ventilating and other purposes.

These panels are compact in construction and both 500-volt and 220-volt lines are controlled from the one panel-box The bus-bars are mounted upon slate, and there are slate barriers between the 500-volt and 220-volt buses.

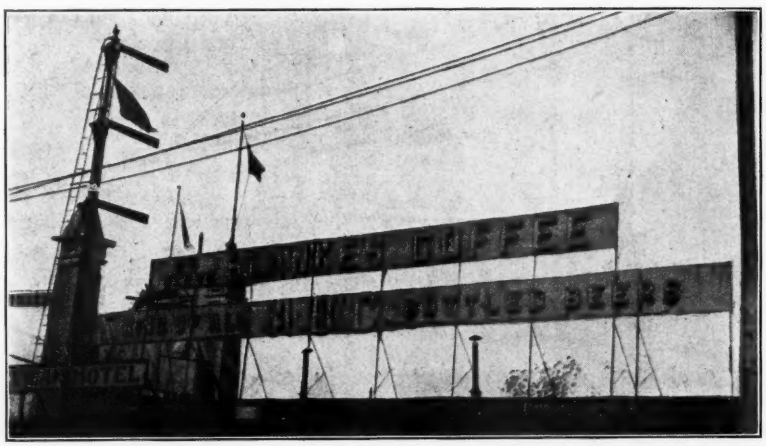
Waterbury & Company is increasing the output of its large factory at Kent avenue, Brooklyn, N. Y., and is now engaged on considerable high-tension work. The concern is installing a large feeder system for the Coney Island & Brooklyn Railway system, and is also at work upon other large contracts for underground transmission, and telephone and telegraph cables.

An important order which the company has recently secured is that covering all the switches and panels to be installed in the New York Hippodrome, the new amusement palace being erected in New York city by Messrs. Thompson & Dundy.

Large Flashed Sign at the St. Louis Exposition.

The Reynolds Manufacturing Company, Chicago, Ill., built the largest flashed sign known at the present time. It was erected at the main entrance to the World's Fair, St. Louis, Mo. The sign was on the roof of the terminal station of the Olive street car line. It was about sixty feet long, thirty feet high above the roof, and the letters were two and four feet high, respectively. The letters were of the grooved type, and contained eight-candle-power lamps throughout. The sign was double-faced, and was flashed on alternate sides. When one side was lighted the other was dark. There were about twenty flashes per minute. A No. 233 Dull's carbon series-type flasher was used. There are not more than half a dozen of these flashers in use, as there are very few loads of this size to be flashed.

In this type of flasher the current is broken on both metal and carbon six times in series on each branch. There were about 23,000 watts on each side of the flasher at about 230 volts, a two-wire system being used. When the machine was ordered, it was intended for 12,000 watts, but the load was later increased at the request of the owner.



Large Flashed Sign at St. Louis Exposition.

As originally designed, the arc jumped over a three-inch air-gap, and it was necessary to increase this air-gap to five inches between metals of opposite polarity with the heavier load. The sign was run about eight hours a day. It was installed by E. H. Abadie & Company, of St. Louis, which was also the contractor for the sign work.

The Baikal Lake Section of the Siberian Railway.

The total cost of the Baikal lake section of the Siberian railway was about $30,000,000, amounting to approximately $186,300 per mile. Preliminary studies and geological investigations since 1895 have cost over $540,000. The track is laid with T-rails weighing sixty-four pounds per yard. The bridges have steel spans on masonry piers, and the viaducts are of masonry. The line has a capacity of fourteen trains per twenty-four hours in both directions. Construction was commenced in the spring of 1903, and was intended to be completed early in 1905. The military necessity for the line, however, led to the work being pushed early in the last year, and the road was opened to a limited traffic in October, 1904.

The Duncan Direct-Current Wattmeter.

The Duncan Electric Manufacturing Company, Lafayette, Ind., manufactures a direct-current wattmeter which embodies a number of new improvements. The principal features involved in the recent developments have been along the lines of increasing the driving torque and, incidentally, the retardation so that the accuracy on very small loads can be depended upon to a degree not attainable heretofore. Another important change recently accomplished is one of design, whereby the bearings may be readily inspected and renewal of spindle points and jewels made with the greatest possible ease, without having to use special tools.

Fig. 1 shows the Duncan direct-current wattmeter, with its cover in position. This cover is removable from the front, thereby permitting the meter to be installed quite close to the ceiling. It fits closely into a felt-lined groove, making the instrument absolutely dust and insect-proof. By way of testing the dust-proof qualities of the meter, the makers installed one of them in a flouring mill eleven months ago, and upon being inspected three weeks ago it was found to be as clean and free from dust within as when first installed.

FIG. 1.—VIEW OF THE DUNCAN INTEGRATING WATTMETER.

Fig. 2 shows the meter with cover removed, and Fig. 3 is a side view. The series field coils are machine wound, and then thoroughly taped to ensure perfect insulation. They are clamped to and held on their supporting rods in the simplest possible manner.

The armature is wound with 10,000 turns of No. 41 magnet wire. The makers state that the torque of the armature is from twenty to twenty-five per cent higher and that it does not consume as much energy as the older types. The retarding magnets are put through an artificial ageing process requiring six months, and by the time they are put into the meter they are guaranteed to be proof against becoming weak, even in the presence of strong external fields. This quality causes the meter to maintain its accuracy indefinitely and it will not change its characteristic after it has been calibrated at the factory. The retarding disc is made from the purest aluminum obtainable and is accurately weighed and balanced before being assembled.

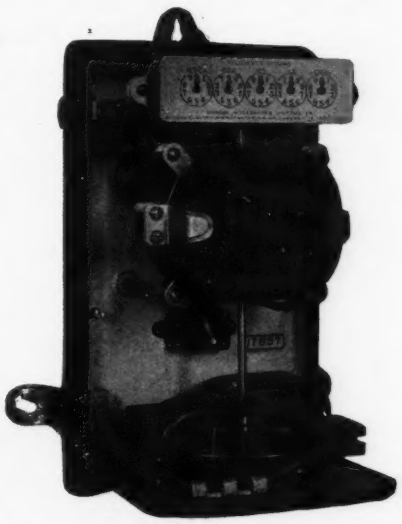


FIG. 2.—DUNCAN INTEGRATING WATTMETER, WITH COVER REMOVED.

A recent improvement in the construction of the Duncan meter is the "visual" bearing and "threadless" jewel-post arrangement. The detachable spindle point may be taken out and inserted again without the slightest inconvenience. No special tools are necessary and the difficulties of the older clumsy and more awkward methods of renewing pivots are completely and successfully overcome. The "threadless" jewel post, as the name implies, is bereft of threads and is held firmly in position by a wire spring. Its insertion or removal requires but a moment and no trouble is experienced from the stripping or binding of threads.

To prevent the brushes from getting out of alignment, they are mounted upon a suitable moulded lava support and, being firmly secured thereto, their tension upon the commutator is also maintained constant.

No part in the make-up of a commutator meter is productive of more trouble than the commutator itself. The Duncan Electric Manufacturing Company has made numerous experiments during the past two years in an effort to produce an alloy that would be especially suitable for use with commutators. In this it has apparently succeeded. Their composition will not tarnish and the commutators do not turn black after having been in service for a short time.

To overcome effectually the friction of the bearings and enable the meter to measure accurately very small loads, a compensating coil is employed which is rigidly fixed within the front series field coil and in close proximity to the armature. Its supplemental torque effect upon the armature is varied by cutting in or out of circuit a portion of the turns comprising it. The terminals of the various groups of windings of the coil are connected to corresponding contacts of a "multipoint" switch having a small lever or arm. This arm makes connection with any of the contacts and brings into circuit any number of turns desirable. To compensate for friction, the lever of the "multipoint" switch is moved toward F, thereby cutting in turns of the compensating coil, and to compensate for creeping the lever is moved toward S, thus cutting out turns from the coil. These changes require but an instant and are absolutely permanent. There is no pushing in or out of a loose compensating coil which changes its position every time an attempt is made to fasten it,

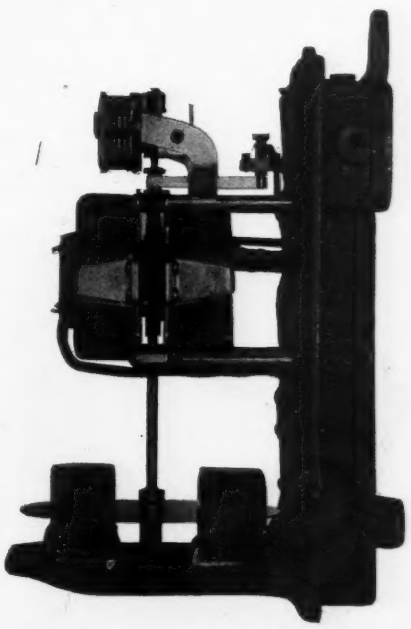


FIG. 3.—SIDE VIEW OF DUNCAN INTEGRATING WATTMETER.

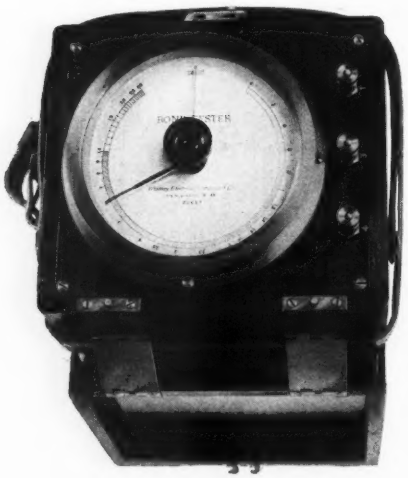
neither is there any change of position to contend with every time the series field coils are subjected to abnormal rushes of current. The range of the compensating coil is exceptionally great and with its switch arm set for any given number of turns or compensation, it may be absolutely depended upon for permanency.

The binding-posts in the Duncan meter are made fireproof and mark a great improvement. No wood or other combustible material is employed in their construction, but instead, a specially prepared insulating fibre that is chemically treated with tungstate of sodium.

The appearance of the meter is particularly pleasing. Its finish is that of a semi-dull, hard-rubber black. The nameplate is silvered. The dials are extremely large and are made of porcelain; they have no constants and read direct in thousands of watt-hours (kilowatt-hours).

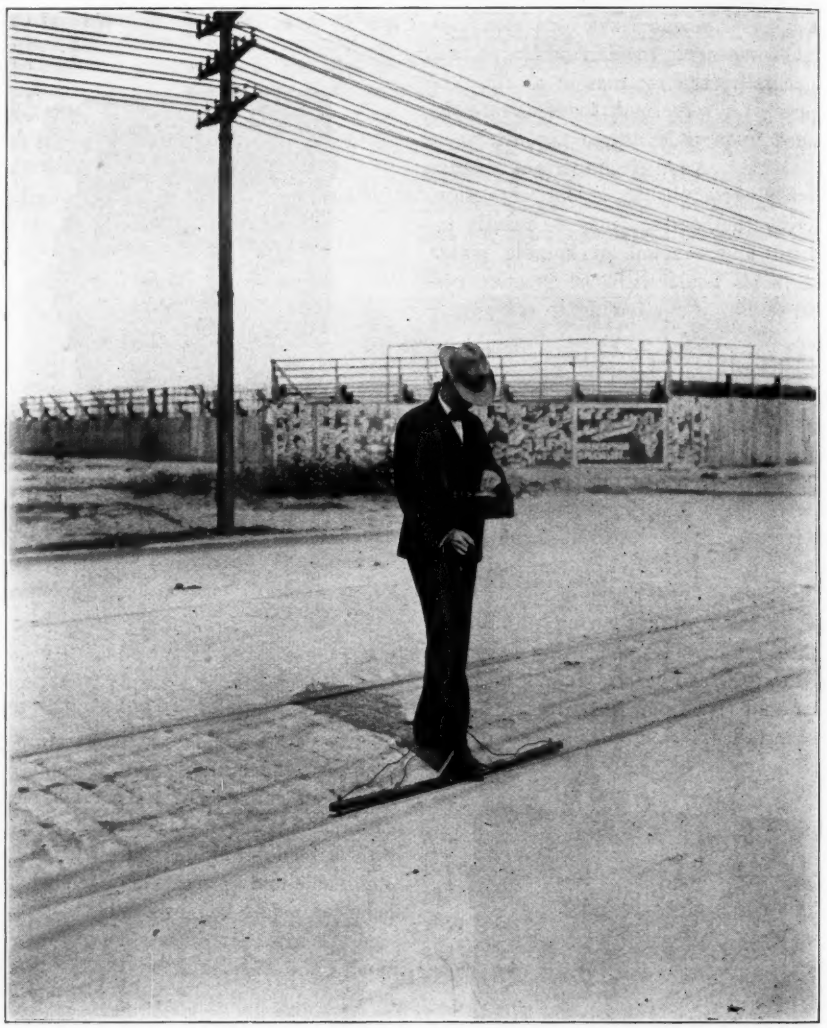
Direct-Reading Bond Tester.

The Whitney Electrical Instrument Company, Penacook, N. H., is placing on the market a new direct-reading bond tester, which is shown in Fig. 1. It is light and compact, so that it may be carried about for long periods by the observer without fatigue, and it will show the resistance of the bond under test directly on a scale which reads in terms of the number of feet of length of uncut rail, whose resistance equals that of the bond. It will show instantaneously whether the bond resistance is above or below any predetermined value. A single observer can take all readings.



DIRECT-READING BOND TESTER.

The method of using the bond tester is shown in Fig. 2. The instrument is supported by a strap passing around the neck of the observer. The strap, in conjunction with the cover—which opens downward at right angles to the top of the tester—holds the device securely in a horizontal position. By adjusting the strap length, the dial can be brought to a definite distance from the observer's eye.



METHOD OF USING DIRECT-READING BOND TESTER.

To make a reading, the contact bar is connected up to the instrument by means of flexible cords which are furnished for the purpose. All cords and binding-posts are numbered to facilitate proper connection. The contact bar is placed on the rail, with the two more closely adjacent rail points spanning the joint. The needle coming through the dial—shown in Fig. 1—will deflect from its zero position. The needle is brought back to zero by rotating the hard rubber button in the centre of the glass cover. The resistance of the bond is shown on a scale by the position of the pointer, which is moved by the button.

If it is desired to ascertain whether the resistance of the bond is or is not greater than a predetermined amount, the pointer operated by the hard rubber button is first set to the predetermined value. When the contact bar is placed in position on the rail, the small needle will deflect either to the right or the left of its zero position, depending upon the direction in which the current is passing through the rail.

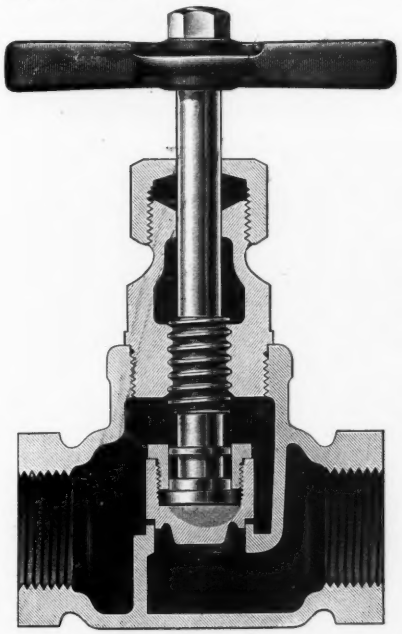
The range of the bond tester includes all resistances from zero up to the equivalent of a length of thirty feet of rail. The length of the scale is about fifteen inches.

The apparatus measures five and one-quarter by eight and one-quarter by seven and one-half inches over all, and weighs about six pounds. The contact bar is hinged at the centre of its lower member, and where the vertical bar joins the lower member. The whole device will fold into a package one and one-half by three by thirty-six inches.

Machado & Roller, 203 Broadway, New York city, are general agents for this tester.

The Hancock Valves.

The Hancock globe, angle, sixty degrees and cross valves are made screwed and flanged in sizes up to three inches. These valves are made of special composition giving great strength and resistance to wear. They are made one standard only, for all pressures. Under actual test, the bodies of these valves will stand a pressure of 4,000 pounds per square inch without breaking and are tight with a water pressure of more than 1,000 pounds per square inch. The company's guarantee is that every



HANCOCK GLOBE VALVE.

type of Hancock valve has been tested with 1,000 pounds water pressure and found tight before leaving its works, and the valves are guaranteed for 500 pounds steam pressure.

In order that the valve seat may be hard and durable, the body is made of a specially hard and tough mixture. The discs are made of a special mixture which does not contain any zinc. The spindles are all made of Tobin bronze. Experience has demonstrated that a Tobin bronze spindle working in a special composition bonnet will not cut under the highest steam pressures.

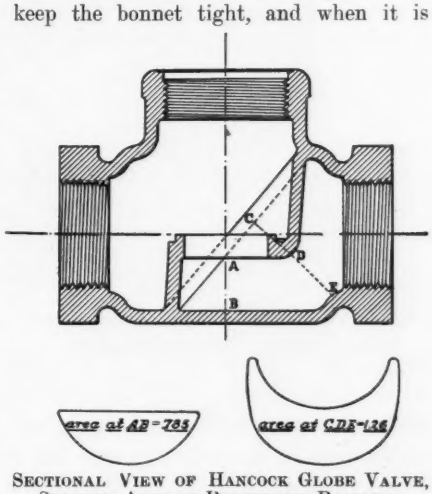
These valves are made after the same general design as the Hancock main steam valves, used on locomotives for a number of years and found to give perfect satisfaction with the high steam pressures carried. From the sketch shown herewith of a one-inch globe valve, it will be seen that the area of the most contracted part of the valve is ample and of full size.

These valves have been designed so that the metal is distributed to give uniform strength throughout, and the areas have not been reduced or contracted for the purpose of reducing the weight.

Attention is called to the way the valve is guided on the stem. An inspection of the section of this valve will show two collars or guides upon the stem which guide the disc nut, compelling the disc to always seat squarely and preventing the disc from cocking.

The valve seat is flat. This form of seat has many advantages. The valve disc has a projection on it which serves two purposes. In the first place it acts as a guide when the seat is ground. In the second place, this lip or projection on the disc prevents the cutting of the seat by the wire drawing of the steam when the valve is cracked or slightly open. Again, when the valve is slightly raised from its seat as shown in the illustration with the lip entering slightly, it allows the escaping steam to clean the seat, so that when the valve is seated all dirt and foreign matter have been washed or blown completely off the seat. This is a most important feature, as experience has fully demonstrated that when the Hancock valve begins to leak it requires very little regrinding to make it tight. This is accomplished so easily that a tight valve can be maintained for a great length of time.

The bonnets of these valves are made with a long thread engaging the body of the valve, and the shoulder on the bonnet is made narrow. By means of this narrow seat on the shoulder, it is possible to keep the bonnet tight, and when it is



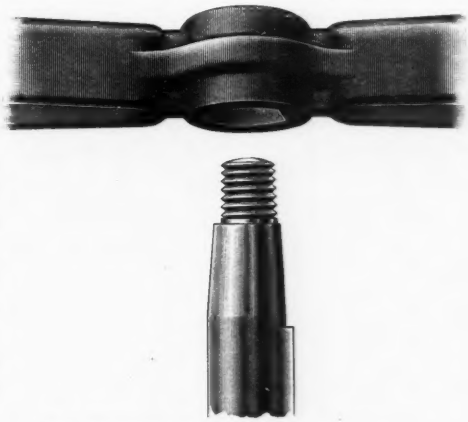
SECTIONAL VIEW OF HANCOCK GLOBE VALVE, SHOWING AREA OF RESTRICTED PASSAGES.

desired to unscrew the bonnet, it can be easily done.

When it is necessary to regrind the valve to its seat, the bonnet is removed, the disc nut unscrewed from the disc. A piece of wood can be inserted in the disc, enabling it to be ground perfectly as the projection on the disc guides it. It not being necessary to have any special regrinding tools for this purpose.

The tee handle shown on the Hancock valve has proved to be very efficient in opening and closing. It has become very popular among the users of these valves, and the demand is so universal that all valves sent out are equipped with the tee handle.

The illustration shows the peculiar method of attaching the tee handle. The hole in the handle is made tapering with one side flat and the spindle of the valve is also made tapering with one side flat-



TEE HANDLE, HANCOCK GLOBE VALVE.

tened to receive the handle, the tee handle being held on the spindle by means of a nut. The flattened side holds the handle rigidly in its place, and the taper enables the handle to be drawn tightly to the spindle, avoiding any annoyance from handles or wheels working loose.

The Hancock valves are made by the Hancock Inspirator Company, whose general office and salesroom is at 85-87-89 Liberty street, New York, with a western branch office and salesroom at 22-24-26 South Canal street, Chicago, Ill. The company's factory is at Boston, Mass.

Flywheel Accidents and Their Prevention.

Statistics show that the number of serious accidents resulting from racing engines is steadily increasing, and it is reasonable to suppose that for every such accident reported in the public prints there are many minor, yet costly, ones that are never heard of outside the plants in which they occur.

These accidents happen in spite of thorough inspections and such other precautions as an efficient engineer may employ, and generally the least of them does sufficient damage to necessitate a

brief shutdown for repairs, with a consequent loss of time and profits.

Occasionally the engineer, perhaps at the risk of his life, is able to reach the throttle in time to avert a serious disaster; but very often he fails to do so and the engine gains speed until it bursts the flywheel, wrecks itself, demolishes its surroundings and maims or kills whoever happens to be in the path of the flying iron.

These are the cases which are chronicled in the daily press and which are causing more and more of those who, from a mistaken sense of security, have heretofore given the matter little or no attention, to seek some method by which "racing" may effectually be prevented.

The Monarch engine-stop and speed limit system is made to meet just such emergencies, and a booklet of testimonials entitled "As Others See Us," recently issued by the manufacturer of this device, the Consolidated Engine-Stop Company, 100 Broadway, New York city, testifies to the fact that the Monarch system has been the means of preventing many engine accidents. This system is connected directly to the main flywheel shaft, and when the engine exceeds the speed at which the speed limit is set, no matter from what cause, the speed limit operates the stop automatically and positively by electrical contact, the steam being immediately shut off and a gong rung notifying the engineer. The stop may also be operated from any part of the shop by means of especially devised push switches, conveniently placed and thoroughly protected from meddlesome employés.

The wide use of electric motors for power purposes has shown the desirability of a device which will do for the electric motor what the engine-stop does for the steam engine, and this has also been produced by the above-named company.

The Monarch motor-stop places an electric motor or a motor-driven machine under absolute control from any part of the works through snap switches of an improved dial pattern, a single turn of which operates a separate battery system which throws the main switch at the board. These switches, while carefully protected, are always available for immediate use.

The switchboard is an attractive sheet of marble or slate, carrying a testing apparatus as well as the main switchboard. It may be used as a main switchboard, or placed in the office or other part of the plant for use only in emergencies.

The Monarch motor-stop may be connected with any size of motor, using any kind of current. It will stop a machine under load in from two to five seconds, and may be arranged to protect any desired number of motors.

This new apparatus gives the company a system of power-control and speed-limiting devices which meets every requirement of both electric and steam-driven machinery.

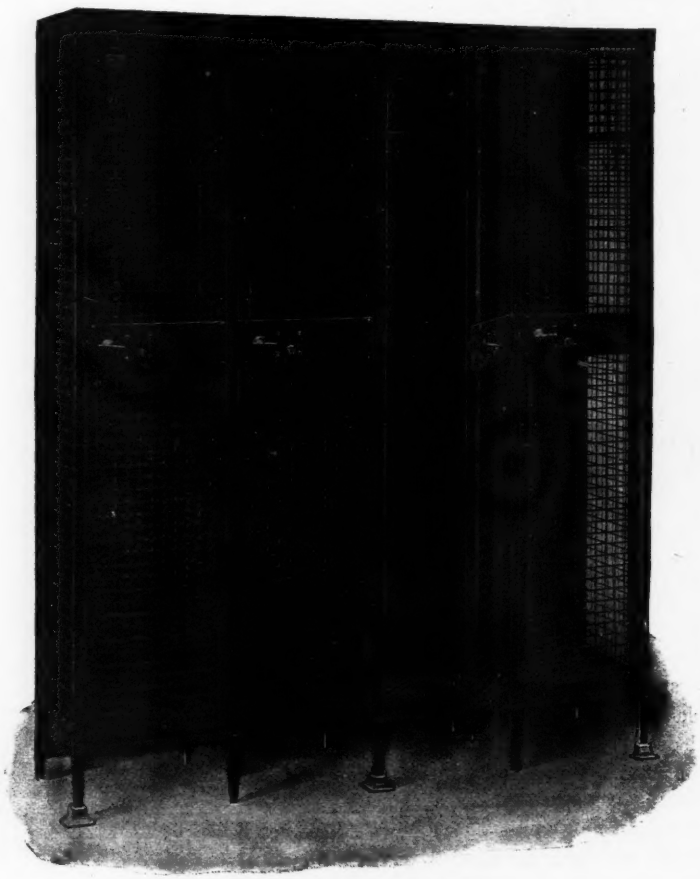
The "Pen-Dar" All-Steel Locker.

The solution of the problem as to the method or system to be adopted for the disposition of wearing apparel of employés, while engaged in performing their daily labor, has become a difficult one for the managers of large manufacturing plants, railroad companies and in fact any place or building where a large number of people are employed. Edward Darby & Sons Company, Incorporated, Philadelphia, Pa., has introduced an all-steel locker which meets all requirements and overcomes all the objections met with in older styles of clothes lockers or receptacles.

The old method of using wooden lockers or compartments for clothes has been admitted by all interested in the subject to be unhealthy and unsanitary. Being entirely of wood, they were like a closed box, allowing of no ventilation, and dust, dirt and so on from umbrellas, boots and clothes soon collected in the corners, on the sides, bottoms and shelves, until they become dangerous and unhealthy. The clothes left in them, especially if they were the least damp, soon became mouldy and foul-smelling. This has been overcome by the introduction of the "Pen-Dar" metal locker.

This locker is constructed entirely of steel. The frame and supports being of angles well riveted and braced. The fronts, sides and bottoms are of open mesh, and allow of a free circulation of air. The backs and tops are of sheet steel. Each locker has a shelf, nickel-plated coat hooks, and is fitted with a three-point combination lock. This device, which is ingenious and entirely new, securely fastens the door at the top, bottom and centre with one motion. Duplicate keys are provided and each set is mastered. They are made in groups of a convenient number and are shipped knock-down or set up and crated.

These lockers have been endorsed by the fire underwriters and insurance companies throughout the country. Being of open mesh, the contents can be inspected at will and any fire arising within the locker can be instantly discovered. If for any reason the necessity for fumigation should arise, an entire locker room can be so treated without removing a single garment from the locker. They are finished in the finest manner, and when set present a neat and attractive appearance. The great number of lockers installed by this company since first placing them on the market is sufficient proof that they fill a long-felt want, and are all that their manufacturer claims for them.



THE "PEN-DAR" ALL-STEEL LOCKER.

A New Single-Phase Integrating Wattmeter.

The Westinghouse Electric and Manufacturing Company has developed the type B Westinghouse integrating wattmeter for use upon single-phase circuits of 7,200 and 16,000 alternations. It shows improvements in a number of features that

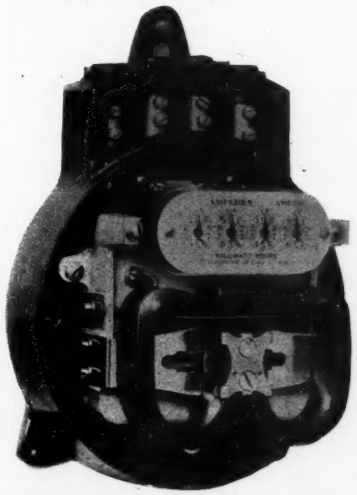


FIG. 1.—WESTINGHOUSE INTEGRATING WATTMETER WITH COVER REMOVED.

give it an increased efficiency and long-lived calibration.

In every essential it follows the Westinghouse standard designs, employing the principle of shunting the greater portion of the field due to the shunt winding, and allowing only a small portion of it to combine with the series field to produce a torque on the disc. By this means good load-voltage and frequency curves are obtained. By a change in the design of the electromagnet the effect upon the disc is made double that produced in the type A, with the same small shunt loss, the same accuracy upon light work and a minimum amount of variation in performance due to changes in voltage and frequency.

Fig. 1 shows the type B integrating wattmeter with cover removed. It is compact in form and can be installed in a small space, the front connections on the top of the meter case adding materially to the convenience in installation. The fact that it is a sealed meter, with the original calibration preserved under the manufacturer's seal, and requires no adjustment when put into service also reduces the cost and the labor of installation. It is only necessary to fasten the meter securely to its supports by three screws, to connect the line wires to the four terminals and to take the initial reading of the meter. It will be noted that the use of four binding-posts, and the connecting of both sides of the circuit to the meter, prevents its stoppage by removing a shunt lead, without interruption to the circuit. The shunt connection is permanently made inside the meter. All of the working parts are attached to a single casting. This gives strength and rigidity, and ensures a perfect alignment and reduces the liability of injury from jarring. The moving element retains the lightness of that of previous types, with a greatly increased torque. The magnets are well aged and mounted upon one bracket, which ensures perfect alignment. The use of two magnets permits the adoption of a wider air-gap, thus eliminating the danger of the disc rubbing. Adjustments for frequency, speed and friction are conveniently located and easily made. At full load the disc makes twenty-five revolutions per minute.

The essential features of the ball bearing in the type A meter are retained in the type B. The lower end of the shaft, upon which the rotating disc is mounted, is fitted with a sapphire jewel slightly cupped. A corresponding jewel is placed in the end of the adjusting screw which forms the lower half of the bearing, and into the hollow space between the jewels a hardened steel ball is introduced. The polished steel surface of the ball is slightly less in radius than the jeweled cups, reducing the friction to an inap-

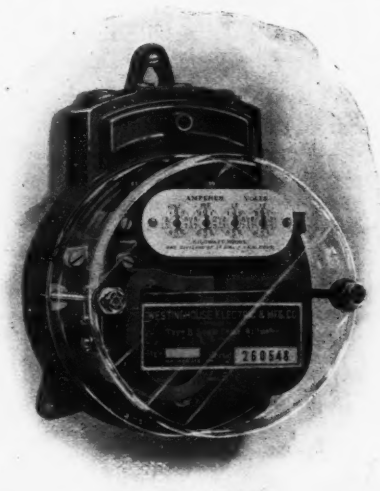


FIG. 2.—WESTINGHOUSE INTEGRATING WATTMETER WITH GLASS COVER.

preciable amount, owing to the smallness of the points of contact.

The upper bearing is new and presents some excellent features. The shaft which supports the disc is drilled out at its upper end slightly larger than the pin which is attached to the upper screw. The diameter is reduced at one point in its depth to form a bearing for the pin. At the bottom of the hole is placed a small piece of felt which is impregnated with oil. Capillary attraction causes the lubricant to creep upward, oiling the bearing. Friction is thus reduced to a minimum, decreasing the wear and eliminating noise.

FIG. 3.—WESTINGHOUSE INTEGRATING WATTMETER WITH METAL CASE.

A four-dial counter is employed; its construction and the connection with the disc shaft being so perfect that no friction effects are perceptible. On meters of less than 3.84-kilowatt capacity the first dial reads in the tenths of kilowatt-hour; in larger capacities the first dial records units.

The meter records directly without the use of a constant. The accuracy is not affected by reasonable variation in voltage and it records correctly from two per cent of full load to fifty per cent overload, and under all conditions of power-factor and wave-form.

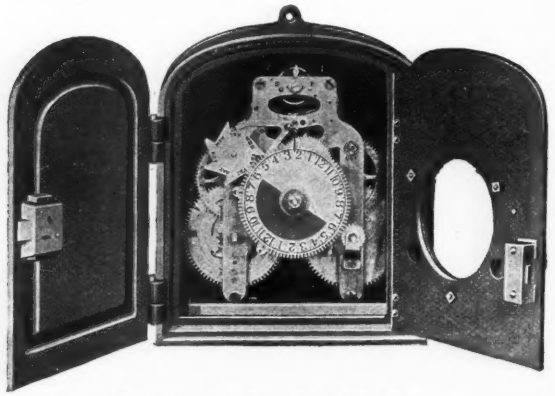
Fig. 2 shows the meter furnished with a glass cover. It is also furnished with a metal instead of a glass cover as shown in Fig. 3.

Long-Distance Telegraphy.

During the past year the Indo-European Cable Company has had in operation the Wheatstone system over the full length of its line. This route starts at London and terminates at Teheran, Persia, the distance being about 3,800 miles. Recently these messages, as they have come into London, have been relayed to Liverpool and Manchester instead of being retransmitted by Morse. The messages are received as clearly at these places as they are in London. The two cities exchange their messages direct with Teheran.

The Hartford Time Switch.

Two new types of automatic switches have been put on the market by the Hartford Time Switch Company, Hartford, Ct., that should prove of interest to central station managers and contractors, as they greatly widen the field of usefulness for automatic switches.



HARTFORD AUTOMATIC TIME SWITCH.

The first model of the Hartford automatic time switch is known as type "B," which, it is claimed, has fully demonstrated, by long service in actual operation, its reliability to work continuously and successfully under all conditions, in the varying temperatures of summer and winter, and in protected and unprotected positions.

Type "C," one of the new models, has been put out to meet the demand for a switch that would automatically omit throwing the switch on Sunday, without in any way interfering with its regular operation on week-days. This switch is not complicated, and when set up requires no more attention than the type "B" switch.

The type "D" switch was designed particularly for controlling window and sign lighting on thoroughfares which have crowds at certain regular periods daily, such as streets in the vicinity of theatres and those leading to railroad stations, with suburban traffic before and after the theatre. This switch throws the current on for two periods each day. For example, it can be set to light windows and signs from 5 to 8.30 P. M. and again from 10 to 12 P. M., or at such other hours as the user may desire. It gives the maximum of useful display lighting with the minimum of expense. This switch can be furnished combined with the automatic cut-out feature of type "C."

Many switches have been made to fill special requirements, and there are few conditions, where an automatic switch can be used, that the Hartford switch can not be arranged to fill. All switches are equipped with a high-grade Seth Thomas marine clock movement; the switch is of the rotary type having double contacts of ample capacity and thoroughly insulated. The entire mechanism is enclosed in a japanned iron case with double doors and is dust and weatherproof. The subtreasury lock used on the outer door prevents any unauthorized tampering with the mechanism. All switches are furnished wired and ready for immediate installation.

A. Hall Berry, vice-president, F. H. Lovell & Company, 97-101 Warren street, New York city, is sole sales agent for the Hartford Time Switch Company.

The Blake Insulated Staples.

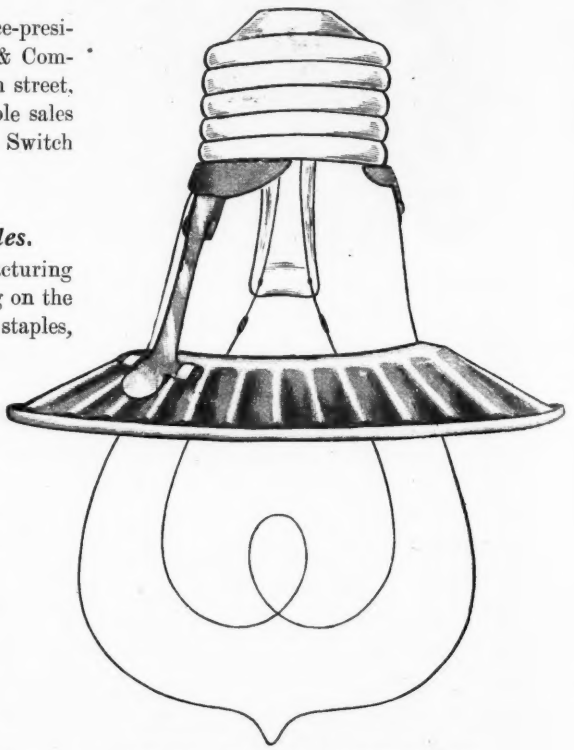
The Blake Signal and Manufacturing Company, Boston, Mass., is placing on the market four sizes of insulated staples, which are shown full size in the accompanying cut. These four sizes cover the demand of the field for insulated staples for low-voltage wiring, such as telephone, telegraph, annunciator, bell and all battery circuits. The special features are that the fibre forms a good insulating and mechanical protection, preventing the metal of the staples from coming into contact with and damaging the insulation of the wiring, causing short-circuits; the fibre is securely attached so that it can not come off in driving; flat-head, substantial shanks and sharp points give excellent driving qualities.

The cost of the staples is less than the screws alone used in cleat work, and the insulating and mechanical protection is stated to be as good. Wiring can be done more quickly with these insulated staples than with either bare staples or cleats. The staples already have a large and increasing sale among the Bell and independent telephone companies, and also for telegraph, fire-alarm, annunciator and other low-voltage wiring.

BLAKE INSULATED STAPLES.

A New "Sarco" Specialty.

The Sarco Company, New York city, has placed upon the market a new form of special two-light reflector for railway, steamship, trolley car and any outside or exposed service. The great success with which the company has marketed the regular "Sarco" two-light reflector has indicated the possibilities for a successful handling of the new form of special apparatus. This type of reflector is designed for service where a substantial reflector is required, which will not be affected by rough usage or exposure to the weather.



"SARCO" TWO-LIGHT REFLECTOR LAMP.

The special two-light reflector comprises all the advantages of the regular two-light reflector, allowing the light to penetrate to the top and bottom of the lamp, and, in addition, has the feature of allowing the removal of the lamp by bending back the German silver springs without removing the lamp from the socket. This makes the reflector especially adapted to railway service, where frequent cleaning is necessary.

The reflector is claimed to be shadowless. It possesses great reflecting surface, and is easily applied.

The "Interpole" Variable-Speed Motor.

The Electro-Dynamic Company, Bayonne, N. J., has placed on the market a new motor (shown in Figs. 1 and 2) which is essentially a variable-speed motor, but which can also be used on constant-speed work. It was designed especially to drive machine tools, pumps, blowers, woodworking machinery and all other classes of machines, either driving the same directly or in groups. The motor operates on any two-wire, direct-current circuit from 110 to 500 volts.

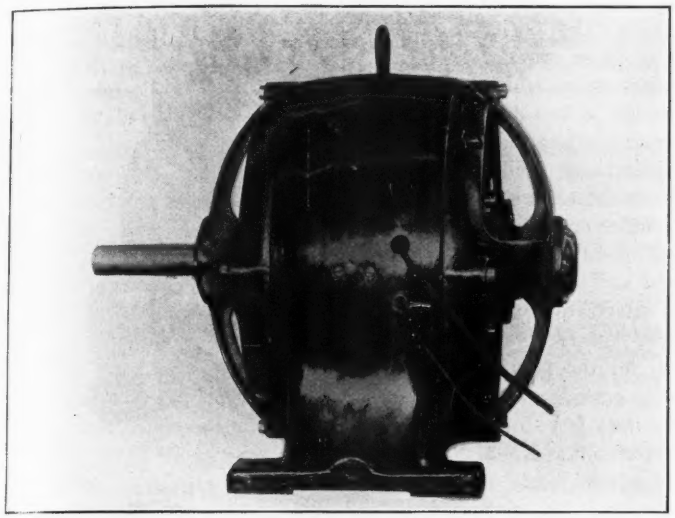


FIG. 1.—ASSEMBLED "INTERPOLE" MOTOR, SHOWING BEARING HOUSING.

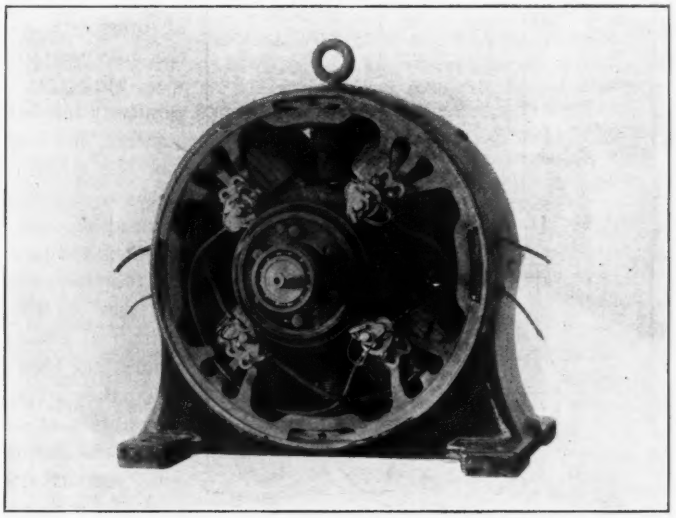


FIG. 2.—ASSEMBLED MOTOR, SHOWING "INTERPOLES" AND BALL BEARINGS.

In any direct-current, shunt-wound motor having a variable speed, the strength of the main field-poles must be decreased if the speed of rotation is to be increased. Sparking at the brushes will then result, and if an attempt is made to fit the motor to run in either direction by shifting the brushes to positions equidistant between the poles, the sparking will be still further increased. In this motor, however, the brushes are placed equidistant between the poles, and it is capable of reversing its direction of rotation without sparking with variable load as well as with variable speed. This is accomplished by means of the auxiliary poles, which may be seen in Fig. 2, between the main poles.

The coils in the auxiliary poles are so proportioned and arranged as to give the proper field for commutation, and as these coils are connected in series with the armature, weakening the field of commutation by increased load is prevented, and the auxiliary poles produce a compensatory field of commutation independently of the main field, which is weakened with an increased number of revolutions of the armature. The function or effect of the auxiliary poles is independent of the direction of rotation of the armature, for if the latter is reversed, the current in the auxiliary field is also reversed. The armature is shown in Fig. 3. The motor applied to a Niles-Bement-Pond horizontal boring mill is shown in Fig. 4, and the wiring diagram of the motor is shown in Fig. 5.

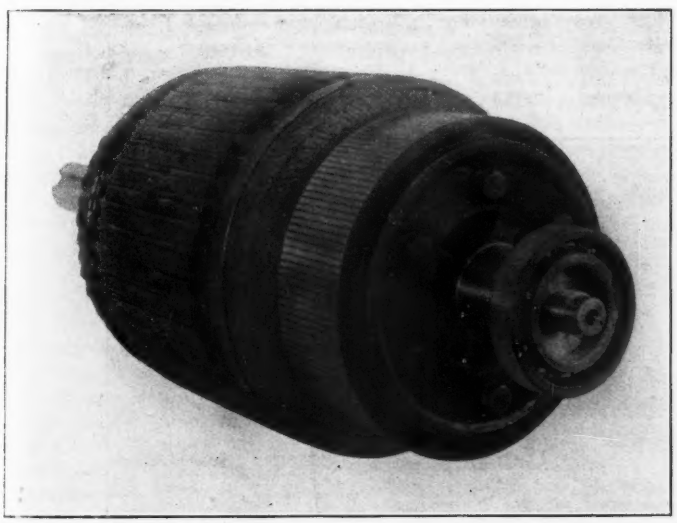


FIG. 3.—ARMATURE, SHOWING BALL BEARINGS.

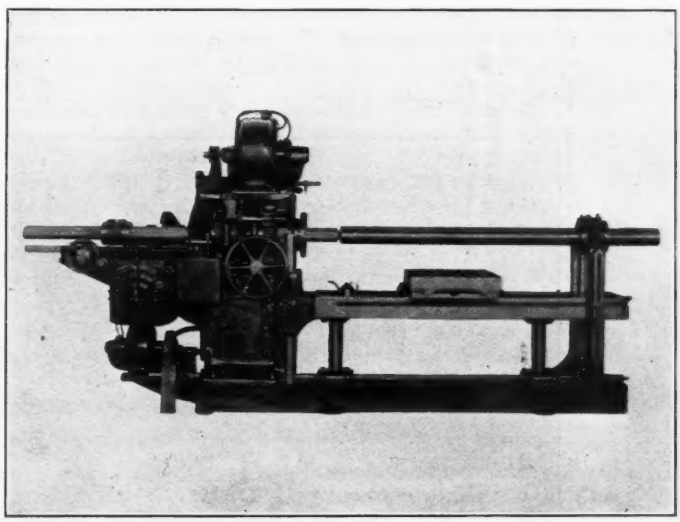


FIG. 4.—"INTERPOLE" MOTOR DRIVING HORIZONTAL BORING MILL.

A striking feature of the motor is the introduction of four auxiliary poles in the field between the main poles of the motor. The main poles are in shunt with the armature, while the auxiliary poles, which are considerably smaller than the others, are in series with each other and with the armature.

Another novel feature of this motor is the use of ball bearings in place of the ordinary journal bearing. This bearing consists of two races, one of which is fastened to the armature shaft, and the other to the bearing housing. Between

the balls are placed spring separators which are packed with mineral wool. This mineral wool takes up the lubricant and feeds it gradually to the bearing. The only attention required for the bearing

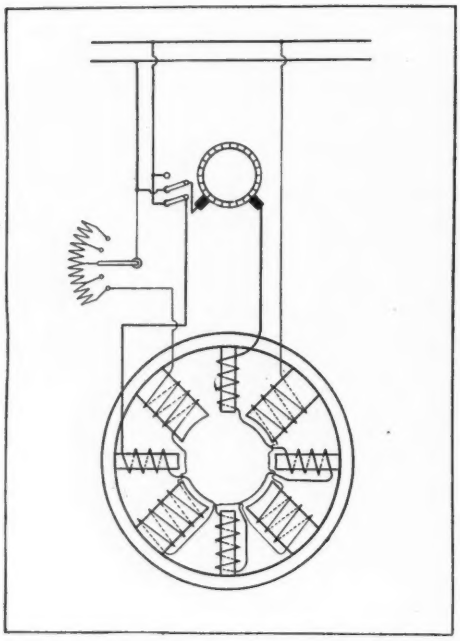


FIG. 5 —WIRING DIAGRAM OF "INTERPOLE" MOTOR.

is to have the lubricant renewed once about every six months. The bearing is shown very plainly in position on the end of the armature shaft in Fig. 2.

The motor has been designed so that it will operate in any position, even with the shaft vertical, without any change being made in the machine. It is readily adaptable for use open, semi-enclosed or enclosed. The average speed variation is five per cent from full load to no load, at any set speed of the controller. This is a particularly important point to be considered when machine tools are equipped with motors for variable-speed duty.

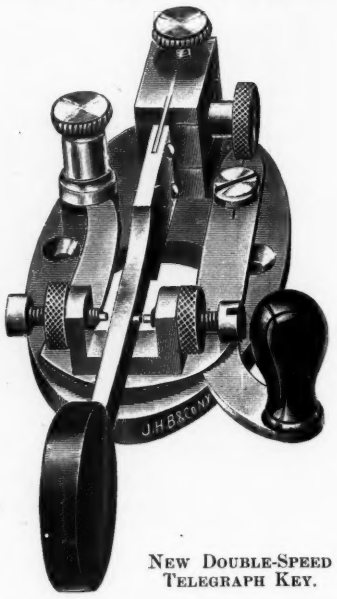
The Electrical Department of the Allis-Chalmers Company.

The Bullock Electric Manufacturing Company has within the year just passed come under the control of the Allis-Chalmers Company, and is now the electrical department of that company.

This department has enjoyed a year of prosperity during 1904, and begins the new year with its shops so crowded with work that additional room is imperatively needed, although a two-story building, 300 feet long and 101 feet wide, was but recently completed and added to the equipment. This building is constructed of steel and buff-colored brick. Another addition to the plant, a building four stories in height and to measure 210 feet in length by fifty-five feet in width, is already under contract, and ground has been broken for the foundation. Bids are now being considered for an addition of 12,500 square feet to the area of the machine shop, known as No. 3. The constant expansion of the fields of electrical application assures to the electrical industry continued and increased prosperity. The indications are that the shops of the Bullock Electric Manufacturing Company will be called upon to take care of a great volume of business during the coming year. Not only has the volume of the electrical business been large during the past year, but there has been a marked increase in the size of the units built. Several generators of from 5,000 to 6,000-kilowatt capacity have been turned out and already installed, and there is now being finished a motor-generator set of 8,000 horse-power. This contains the largest electrical motor ever built. The company's facilities for handling large work are exceptional. It has tools and appliances for turning out promptly units of any size up to 10,000-kilowatt capacity.

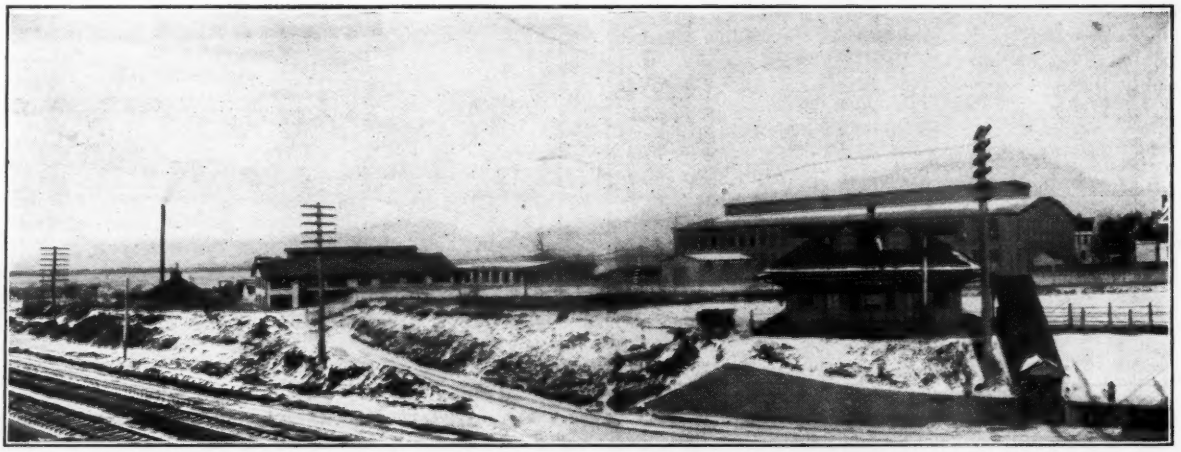
A Double-Speed Telegraph Key.

J. H. Bunnell & Company, 20 Park Place, New York city, are placing on the market a new form of telegraph key, an illustration of which is shown herewith. It is said that this key is condemned by an operator at a first glance, but, on reflection, this judgment is quickly reversed,



NEW DOUBLE-SPEED TELEGRAPH KEY.

and a trial or demonstration creates enthusiasm. The key requires but one-half the motions of the ordinary key, and these are made by a sidewise rocking motion of the hand. This action is easily acquired, and will not bring about telegraphers' cramp; and that those affected with cramp will be helped to recover their speed and style. The key lever moves in a horizontal direction, standing normally between the two points, but in contact with neither. The knob should not be gripped, but allowed free play between the thumb and finger. About one-half the ordinary motions are required in forming signals. For instance, the letter "p" with the ordinary key requires ten movements of the hand—five down and five up; whereas with the double-speed key only six movements of the hand are necessary.



THE ELECTRO-DYNAMIC COMPANY'S PLANT, BAYONNE, N. J.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

MARYLAND POWER PLANT PROJECTED—Plans are being formulated by the Patapsco Electric Light and Power Company for the establishment of a power-house on the Patapsco river, below Ellicott City, Md. It is claimed that in view of the excellent water power afforded by the river at the point selected the operations can be made very profitable.

CONSOLIDATION OF BALTIMORE LIGHTING INTERESTS—The United Electric Light and Power Company, of Baltimore, Md., has purchased a majority of the stock of the Consolidated Gas Company, of Baltimore. This is the beginning of the consummation of plans contemplating the consolidation of the United Electric Light and Power Company and the gas company.

CHICAGO UNION TRACTION COMPANY PAYS INTEREST ON MORTGAGES OF UNDERLYING COMPANIES—The Chicago (Ill.) Union Traction Company paid to Judge Grosscup on December 31, 1904, the sum of $200,000, the interest on the mortgages on the properties of the North and West Chicago street railway companies, thus escaping being declared in default on its leases with these roads.

NEW HIGH-SPEED ELECTRIC LINE IN PENNSYLVANIA—The Shenango Street Railway Company is to build and equip a trolley line from Cambridge Springs to New Castle, Pa. Eventually the road will connect Buffalo and Pittsburg. Among those who are interested are J. M. Guffey and Murray Verner, of Pittsburg, and J. W. Parker, of New York. There will be about eighty miles of new track laid. The cost of the new line and equipment is estimated at $1,500,000.

NEW POWER PLANT IN CALIFORNIA—A power plant is proposed on Bishop creek in Eastern California, about ninety miles from Goldfield, Nev. Water rights have been secured on Bishop creek capable of developing 5,000 horse-power, and the power will be transmitted to the mines at Goldfield and Tonopah, Nev. Surveys for the line have been made and construction work will shortly begin. Among those interested are Tasker Oddie, Tonopah; Rodney Curtis and David Moffat, both of Denver.

TRACTION ALLIANCE IN OHIO AND INDIANA—It has been announced that an alliance of a number of large traction companies in Indiana and Western Ohio is planned. Through lines are to connect the cities of Cleveland, Cincinnati and Toledo, in Ohio, Indianapolis and Fort Wayne, in Indiana, and the smaller places between them. The Elkins-Widener Syndicate, of Philadelphia, and the Cincinnati, Dayton & Toledo Traction Company interests are reported to be behind the deal. A newly incorporated company, known as the Cincinnati Northern, with a capital of $500,000, is also interested.

EXTENSIONS OF THE CENTRAL NEW YORK TELEPHONE COMPANY—The directors of the Central New York Telephone and Telegraph Company have appropriated $2,000,000 for extensions and improvements of the present system. Part of this amount will be spent in the city of Syracuse, N. Y., where a new building is being erected. All the wires will be put underground. The greater part of the amount is to be used in extending the service to the cities in the neighborhood of Syracuse, and to all the smaller towns and hamlets in the central part of New York, and in improving it in the towns which the company has already entered.

THREE-CENT FARES IN CLEVELAND, OHIO—The Cleveland Electric Railway Company, Cleveland, Ohio, is to institute an experiment in three-cent fares for a distance of two miles from the centre of the city on all the lines of the company. The cars on which the three-cent fare will be paid will run only the two miles. On the regular cars, which will go the usual distance, a five-cent fare will be charged. No transfer will be given for a three-cent fare. The trial is the outcome of recent local agitation over the settlement of the street car question in Cleveland, and is for the purpose of demonstrating the practicability of three-cent fares.

RIGHT OF WAY SECURED FOR THE HAMILTON, ANCASTER & BRANTFORD RAILWAY—It is announced that the Hamilton, Ancaster & Brantford Electric Railway (Ontario) has secured the right of way over private property from Toronto to a point in Ancaster Township, through which it has running rights on the highways. The road is to be operated with power from the Cataract Power Company, and will run into Toronto on existing tracks. The company has given a contract for the construction of the railway to Elmer T. Haines & Company, of New York. The railway is capitalized at $300,000, and the road—twenty-three miles in length—is to be bonded for $20,000 a mile. The surveys have already been made and work is to be started at once. The road will be running by next fall.

BONDS ISSUED FOR THE TOLEDO, COLUMBUS & CINCINNATI RAILWAY COMPANY—It is announced that $5,000,000 worth of the $10,000,000 construction bonds of the Toledo, Columbus & Cincinnati Railway Company have been floated. The Toledo, Columbus & Cincinnati is an electric railroad 282 miles long, projected between Toledo and Cincinnati, to pass through Lima, Bellefontaine and Columbus. From Columbus to Cincinnati it will be almost an air line. The road was first known as the Toledo, Columbus, Springfield & Cincinnati, but no progress was made in construction, and the company surrendered its charter to the Toledo, Columbus & Cincinnati Railway Company, which was incorporated a year ago under the laws of Ohio. The construction contracts will be let immediately, and it is expected to have the road open between Toledo and Columbus by next fall, and to Cincinnati in about eighteen months.

ELECTRIC TRAMWAYS TO BE BUILT IN SHANGHAI, CHINA—American contractors are asked to bid for the construction and operation of about twenty-four miles of electric tramways in Shanghai, China; alternative proposals are desired for single-trolley and double-trolley lines. Further information will be supplied by the Shanghai council's agents, Fearson, Daniel & Company, 96 Wall street, New York. A proforma contract is open to inspection at their office and prospective bidders can obtain copies of the same. The conditions stated in the proforma contract are open to such modifications as tenderers may consider necessary. A deposit of £5,000, or certified security to that amount, must be made payable at date of signature of contract, and forfeit if the concession is not availed of. Sealed tenders endorsed "Tender for Tramway Concession" must be sent to the secretary, municipal council, Shanghai, and must be received on or before March 31, 1905.

NEW YORK-PHILADELPHIA TROLLEY ROAD PLANNED—Plans have been announced for the construction of a shorter trolley line between Camden, N. J., and New York city. Charter papers for the New York-Philadelphia company have been filed with the county clerk of Camden. The new organization has a capital of $4,000,000, and the stock is held in Pennsylvania, New York and New Jersey. The incorporators are A. N. Chandler and H. D. Long, of Philadelphia, and Norman Gray, counsel for the Corporations Company, of Camden. The new company will operate the electric lines which compose the present system between Camden and Jersey City. The various lines will be consolidated into one corporation, controlled by the New York-Philadelphia company. It is proposed to reconstruct the lines, building cutoffs and reducing the distance between the terminals, and double-tracking the entire distance. The time between Philadelphia and New York is to be cut down to three hours. In addition it is planned to construct several subsidiary lines through the smaller towns in central New Jersey. Right of way for these roads is now being obtained, and the work will be started upon the complete organization of the company.

TELEPHONE AND TELEGRAPH.

PHILADELPHIA, PA.—A Bell telephone exchange is to be built at Fourth and Green streets.

PAPILLON, NEB.—The Home Telephone Company has completed a line from Gretna to the state fisheries.

SIOUX CITY, IOWA—The Clark Automatic Telephone Company has installed a telephone system in Sergeant Bluffs.

WEST UNION, IOWA—The Iowa Telephone Company has made extensive improvements to its plant in West Union.

PLEASANTON, KAN.—The farmers living in Rose Hill and Union districts have constructed a line to Pleasanton.

PORTLAND, ORE.—An independent telephone line is being built from Corvallis to the Brown's Bridge neighborhood.

DANBURY, CT.—The Southern New England Telephone Company has constructed a line from North Ridgebury to the Scotland district.

HUNTINGTON, W. VA.—The Southern Bell Telephone and Telegraph Company has purchased the Catlettsburg & Ashland Telephone Company's lines.

NORTH YAKIMA, WASH.—The Ahtanum Telephone Company, capitalized at $750, has been organized to build a telephone line from North Yakima to Ahtanum.

GLOUCESTER, MASS.—The Manchester board of selectmen has granted a franchise to the New England Telephone and Telegraph Company to lay and maintain an underground conduit system.

REYNOLDSVILLE, PA.—The Farmers' Telephone Company will soon extend its line from Reynoldsville to Rathmel, and will, in a short time, connect with the Red Bank Telephone Company.

MISSOULA, MONT.—Active operations have been begun on the new building of the Rocky Mountain Bell Telephone Company, and it is hoped to have the structure ready for occupancy by May 1.

ALPINE, TEX.—All of the private telephone lines in that part of the state are to be consolidated under one management. Some of these lines are more than 100 miles long and run to remote cattle ranches and towns.

FREMONT, NEB.—By the completion of a circuit between the Golden Rod Company's lines in Saunders County and the toll system north of Lincoln, independent telephone service between Fremont and Lincoln is now possible.

CHILLICOTHE, MO.—Announcement has been made of the sale of a half interest in the Chillicothe telephone exchange, owned by Arthur W. McArthur, of Kansas City, to W. H. Ellett, president of the People's Savings Bank, of Chillicothe.

NEW ALBANY, IND.—A number of Clark County farmers will ask for a franchise for a telephone line between Sellersburg and Charlestown and intermediate points, which, when established, will be connected with the Home telephone system in New Albany.

WHITEWOOD, S. D.—C. C. Haas is about to organize a company for the purpose of putting in a telephone line from the Belle Fourche river to Whitewood. He has already constructed two miles of private line. The line will benefit a large number of farmers who live between the river and Whitewood.

JACKSONVILLE, FLA.—The city council of Jacksonville has granted the right to the Bell Telephone Company to absorb the properties of the defunct Jacksonville telephone system. Thirty thousand dollars will be spent by the Bell company in improving the system. The enlarged capacity will be 5,000 telephones.

FREMONT, NEB.—The farmers in Ponoco precinct, Saunders County, who want telephones, have closed arrangements for connection with the lines of the Fremont Telephone Company. They are to put in their own instruments, set the poles and furnish the wires. The installing is to be done by the Fremont company.

GUTHRIE, OKLA.—The Choctaw Telephone Company, of Durant, I. T., has sold all its property, including toll lines to Denison and Paris, Tex., and Hugo, I. T., to the Pioneer Telephone Company, of Guthrie, for $30,000. This sale practically puts the Pioneer company in complete control of both Oklahoma and Indian Territory.

COUNCIL BLUFFS, IOWA—The Nebraska Telephone Company has completed extensions of its lines from Neola to Yorkshire, Portsmouth and Panama on the line of the Chicago, Milwaukee & St. Paul, and these towns are now in connection with the Council Bluffs office of the company. The line will soon be extended to Persia.

TULSA, I. T.—The Pioneer Telephone and Telegraph Company announced recently that it would install a new telephone system in Tulsa with a capacity of 2,200 telephones. This will be an exact duplicate of the system in Muskogee and will cost in the neighborhood of $50,000. Nine new toll lines will be built in Indian Territory by the company during the next six months.

ROANOKE, VA.—The Bell Telephone Company's plants in Roanoke and at Salem, Va., have been purchased by the Virginia & Tennessee company, which operates an exchange in Roanoke, and the two exchanges have been consolidated under the management of the Virginia & Tennessee company. Traffic arrangements have been made to give the new owners connection with the Bell long-distance lines.

MIDDLEBORO, MASS.—The selectmen have granted a petition of the Southern Massachusetts Telephone Company for the privilege of pole rights in the highways leading to Wappanucket, to string wires for the proposed extension of the farmer's telephone line from Middleboro to Lakeville. The Lakeville board has granted a similar franchise. The company proposes to extend these lines into the outskirts in every direction where there is a disposition shown to use them on the part of the residents.

PORTLAND, ME.—The annual meeting of the stockholders of the Eastern Telegraph Company was held in Portland recently, when the following officers for the ensuing year were elected: directors, R. C. Clowry, B. Brooks, of New York; C. F. Ames, of Boston; Frederick Robie, of Gorham; A. Woodle, C. D. Livermore, H. H. White, of Portland. At a meeting of the board of directors the following officers were elected: president, Frederick Robie; treasurer, C. F. Ames; clerk, C. D. Livermore.

WHEELING, W. VA.—The officials of the Belmont Telephone Company have awarded the contract for the installing of the switchboard, central office appliances and telephones for the new Bellaire system to the Stromberg-Carlson Telephone Manufacturing Company, of Rochester, N. Y. The contract provides that the system shall be installed by April first. The building is nearly completed and most of the poles for the new line are up. The exchange will have the capacity of 2,200 telephones. About 800 will be installed at present.

BASIN, UTAH—A movement is on foot for the building of a telephone line from Cisco into the different mining camps of the La Sal district. The principal promoter is J. H. Clark, of the Inter-State company in Gold Basin. The new line will run direct from Cisco to Richardson, and from there through the country *via* Porcupine ranch to Gold Basin, over the Wilson mesa. A branch line will then be extended from Porcupine to Miners' basin and over the range into Beaver basin. Half of the necessary capital has been already subscribed and work is to be started soon.

NEWARK, N. J.—The Glen Ridge borough council recently authorized Mayor Brewer to sign a contract with the New York & New Jersey Telephone Company, by which the latter is to take charge of the fire alarm system of the borough. The contract, dated January 1, 1905, will hold for one year, with a covenant for renewal for four years more, providing the borough council gives three months' notice of its intention to renew. The company is expected to place underground conduits through the streets of the borough with two wires in them to connect with the fire-alarm boxes. At the expiration of the contract the wires are to remain the property of the telephone company. The company contracts to make all repairs and furnish all material for them at cost, plus ten per cent. The council is to pay the company the yearly sum of $420, payable in monthly installments of $35 each.

PERSONAL MENTION.

MR. THOMAS J. GATES has been appointed assistant city electrician of Norfolk, Va., after a competitive examination, in which he was successful over seven other candidates.

MR. EDWARD B. ELLICOTT, city electrician of Chicago, Ill., is to assist Comptroller Edward M. Grout, of New York city, in his investigation into the cost of gas and electric lighting supplied to the city.

LORD KELVIN has consented to be nominated as president of the Faraday Society, to succeed Mr. J. W. Swan. The Faraday Society is the British association devoted to the interests of electrochemistry and electrometallurgy.

MR. H. J. CURI has been appointed general contract agent of the Missouri & Kansas Telephone Company, with headquarters in Kansas City. He was for many years connected with the Bell telephone service in Pittsburg, Pa.

MR. R. L. ADAMS, manager of the Gadsden, Ala., exchange of the Bell Telephone Company, has been made district manager for all the exchanges in the section of Alabama, including Gadsden, Huntsville, Rome, Springville, Chattanooga and Anniston.

MR. R. R. COLLINS, manager of the Silverton, Col., exchange of the Colorado Telephone Company, has been promoted to be district manager of the company's lines in Blanco and Routt counties. His headquarters will be at Steamboat Springs, Col.

MR. BAYARD G. ECKARD has been appointed superintendent of the Easton, Pa., municipal electric light plant. He is a graduate of Lafayette College, and at the time of his appointment was in the New York office of the Westinghouse Electric and Manufacturing Company.

MR. L. K. BURGE has been appointed superintendent of transportation of the Lake Shore Electric Railway Company. He has been superintendent of the eastern division of the road and relieves Mr. R. R. Strehlan, who became general manager of the Springfield & Xenia Railway Company.

MR. W. S. KEMP, who has been connected with the Brookline National Bank for the last ten years as cashier, has become associated with the Holtzer-Cabot Electric Company, of Boston, assuming the duties of secretary and treasurer, a position made vacant by the resignation of the former treasurer, Mr. Ira A. Foster.

MR. P. E. MITCHELL has been appointed general superintendent of the Knoxville, Tenn., Electric Light and Power Company to succeed Mr. W. C. Woolfolk, resigned. Mr. Mitchell has been acting as superintendent for some months past. He will have general supervision of both the railway and lighting departments.

MR. S. C. MIDBERRY, electrician in charge of the Virginia Passenger and Power Company's power plant, in Richmond, Va., has resigned to take up new work in New York city. Mr. Midberry was presented with a handsome seal ring by his associates. He is a graduate of Union Polytechnic Institute, and the students' course at the General Electric Company's works, Schenectady, N. Y.

MR. ALFRED J. THOMPSON, for a number of years actively associated with the Crocker-Wheeler Company, has accepted a position with the Allis-Chalmers Company, and will make his headquarters in New York city. Mr. Thompson possesses the rare quality of being able to close large deals for electrical machinery, and is one of the best-posted men in this line. His wide acquaintance in the field and thorough knowledge of the electrical business will make him a valuable addition to the enterprising staff that the Allis-Chalmers Company has gathered around it.

EDUCATIONAL.

BULLETIN OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY—The bulletin of the Massachusetts Institute of Technology, dated December, 1904, has been issued. It contains a historical sketch of the institution, list of officers, courses in instruction, register of students, alumni associations, statistics of alumni, particulars of the Lowell School for Industrial Foremen and the Lowell School of Design, titles of theses for the class of 1904, and an alphabetical list of officers and students.

ELECTRICAL LECTURES AT UNION COLLEGE—A course of lectures in electricity will be given during the year 1905 at Union College, Schenectady, N. Y., under the auspices of the department of electrical engineering. A partial list of lectures and titles, subject to change, follows: January 17, J. Harden, "High Temperatures;" January 24, C. P. Steinmetz, "General Transformer, Frequency Converter, Etc.;" January 31, W. S. Moody, "Transformer Practice;" February 7, M. O. Troy, "Constant Current Transformer;" February 14, Dr. Whitney, "Principles of Electrochemistry;" February 21, C. P. Steinmetz, "Science and Engineering;" February 28, J. Harden, "Electrochemistry in Agriculture;" March 7, A. G. Davis, "The Engineer and the Patent Law;" March 14, O. Jungren, "Underlying Principles of the Steam Turbine;" March 21, C. P. Steinmetz, "Prime Movers;" March 28, A. L. Rohrer, "Cost of Power;" April 4, W. I. Slichter, "Some Characteristics of Railway Motors;" April 11, S. T. Dodd, "The Development of the Railway Motor;" April 18, W. B. Potter, "Electric Railways;" April 25, C. P. Steinmetz, "Lightning, and Lightning Protection;" May 2, M. O. Troy, "Condensers;" May 9, W. S. Andrews, "Radium;" May 16, C. P. Steinmetz, "Unsolved Problems."

ELECTRICAL SECURITIES.

So much had been said and written prior to the opening of the new year concerning the first of January, 1905, being a post from which would be started a general spurt in business activities, that the passing of that date leaves one somewhat in doubt as to whether these predictions were well based. It is a matter of fact, however, that the condition of security values, the first week of the year, is decidedly strong, with no apparent tendency toward retrogression. While there is a feeling in some quarters that new legislation may cause unsettlement of some forms of industry, the consensus of opinion is to the end that no radical change in administration will be inaugurated. If any changes are made the process will be gradual, and with due consideration to conserve, if possible, the interests of all concerned. Recent reports of railroad earnings continue to evidence a condition of prosperity. In the iron and steel industry there is a little disappointment, owing to a shrinkage in the demand, particularly for steel rails. This may mean either that roads are still carrying out the conservative plans initiated last year, or that orders for new work are being held up until the question of raising the funds for them has been settled.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JANUARY 7.

New York:	*Closing.*
Brooklyn Rapid Transit	59¾
Consolidated Gas	196½
General Electric	187
Interborough Rapid Transit	170
Kings County Electric	193½
Manhattan Elevated	166½
Metropolitan Street Railway	115½
New York & New Jersey Telephone	168
Westinghouse Manufacturing Company	195

Boston:	*Closing.*
American Telephone and Telegraph	146
Edison Electric Illuminating	250
Massachusetts Electric	58½
New England Telephone	139
Western Telephone and Telegraph preferred	99

Philadelphia:	*Closing.*
Electric Company of America	11⅛
Electric Storage Battery common	77½
Electric Storage Battery preferred	77½
Philadelphia Electric	9⅞
Philadelphia Rapid Transit	17¾
United Gas Improvement	105¼

Chicago:	*Closing.*
Chicago Telephone	143
Chicago Edison Light	168
Metropolitan Elevated preferred	60
National Carbon common	41½
National Carbon preferred	110
Union Traction common	9½
Union Traction preferred	39½

The South Side Elevated carried in December 88,789 passengers, a decrease of 5,148; for the year, 83,323, an increase of 845. Metropolitan for December carried 120,588 passengers, an increase of 106; for the year, 115,196, an increase of 1,762. Northwestern Elevated carried in December 78,263, an increase of 2,004; for the year, 70,041, an increase of 2,091.

ELECTRIC LIGHTING.

CAMDEN, OHIO—The Camden electric light plant has been sold to E. C. Eikenberry for $3,000.

SEATTLE, WASH.—The Seattle Lighting Company has completed plans for new substation buildings. Work will be commenced soon.

MAHANOY CITY, PA.—The Mahanoy City Light, Heat and Power Company has sold its entire plant to the Shenandoah Electric Illuminating Company.

LITHONIA, GA.—The new electric plant of the Panola company, whose power-house is about six miles from Lithonia, has been placed in operation.

MANITOWOC, WIS.—Work will be started at once on the erection of a $200,000 electric plant for furnishing power and heat, the West Side Electric Company, of which ex-Mayor William Rahr is head, having been granted a franchise.

PITMAN GROVE, N. J.—The plant of the Pitman, Clayton & Glassboro Electric Light Company has been sold to M. K. Treichler, of Philadelphia, for $20,000. The plant is a valuable one, and with it go franchises for lighting several towns in the vicinity.

STURGEON, MO.—At a meeting of the board of aldermen a committee consisting of W. S. Harris, J. W. Hulett, O. D. Gray and P. I. King, was appointed to visit Missouri cities and ascertain the cost and advisability of bonding Sturgeon for the installation of an electric light plant.

CHAMBERSBURG, PA.—At a special meeting of the borough council Burgess Sharpe submitted a message vetoing the ordinance authorizing the sale of the Chambersburg light plant to the Chambersburg Light, Heat and Power Company. The chief reason given for the veto is that the price is inadequate.

WILKESBARRE, PA.—Plymouth has been selected as headquarters for the new light company, which recently acquired control of the plants at Nanticoke, Plymouth, Edwardsville, Kingston, Luzerne, Dorranceton and Forty Fort. C. A. Geist and Charles B. Kelsey, who are at the head of the new combine, promise many improvements.

CLEVELAND, OHIO—The Cleveland Electric Illuminating Company in bidding for the work of furnishing arc street lamps to Cleveland for 1905, lowered its price $1.44 per lamp a year. At present the city is paying $75 per lamp a year for arc lights. The new bid of the company is $73.56 per lamp. Since Cleveland has 1,211 lamps the lower price means a saving of $1,743.84 a year.

SALIDA, COL.—Plans are practically complete for the erection of a power plant at Arborville, on the south fork of the Arkansas river fifteen miles north of Salida. The work is being carried on by the Edison Electric Company, of Salida. Ten carloads of machinery, consisting of turbine wheels and piping, have been ordered. The enterprise will involve the expenditure of $75,000 and is backed by local capital. The plan is to furnish cheap electric power to Salida.

NORWICH, CT.—A petition is to be presented to the general assembly at its next session by G. O. Jackson, E. W. Higgins and C. W. Comstock for the right, under the name of the Uncas Power Company, to manufacture, generate, transmit, deliver and sell electricity for any and all purposes in the towns of the county, with the exception of Norwich and New London, and for the right to distribute and sell electricity in Norwich and New London to the amount of not less than twenty-five horse-power per customer. The plant is to be located in Norwich.

NEW HAVEN, CT.—The controlling interest in the Haverhill Electric Company, much of the stock of which is held in New Haven, has been acquired by the same interests that control several gas and electric companies in Massachusetts, including the Springfield Gaslight, the Malden Electric and the Suburban Gas and Electric companies of Revere and Winthrop, Mass. The Haverhill company is capitalized at $150,000 and is a growing and prosperous concern. It pays an annual dividend of eight per cent. The directors of the Springfield Gaslight Company, who now control the Haverhill and other companies, are C. H. Terney, of Hartford; F. P. Royce, Oakes Ames and H. P. Ward, of Boston, Mass.; P. F. Thompson, of New York; Herbert C. Warren, Edwin Bradley and Samuel A. York, of New Haven. The Haverhill company is to be operated as heretofore, and it is stated that no consolidation of plants is planned.

OBITUARY NOTICE.

MR. LOUIS R. SWIFT, toll manager for the Chicago Telephone Company, died on December 31, 1904, at his home, 995 West Oakin street, Chicago, Ill. Mr. Swift was born in Baton Rouge, La., July 28, 1858. He had been a resident of Chicago for twelve years.

LEGAL NOTES.

GENERAL ELECTRIC COMPANY FILES SUITS—A suit was commenced by the filing of a bill of complaint on December 24, 1904, by the General Electric Company against the Moline Incandescent Lamp Company, of Moline, Ill., for infringement of the General Electric Company's patent No. 532,760, issued on a method of sealing the filament support or stem of incandescent lamps to the neck of the lamp bulb. A suit was also commenced on January 6, 1905, by the filing of a bill of complaint against Charles T. Jaeger, doing business in New York city under the name and style of the Jaeger Miniature Lamp Manufacturing Company, for infringement of patent No. 422,219, covering apparatus for exhausting incandescent electric lamps.

MARYLAND TELEPHONE COMPANY CAN ENTER LIGHTING FIELD—Judge Sharp, in circuit court No. 2, Maryland, has sustained the demurrer entered by the Maryland Telephone Company in the suit of Alexander Brown against it, to prevent the company from carrying on an electric lighting business in the city of Baltimore, Md. The opinion was a lengthy one, and went into details of the controversy to a considerable extent. The complainant alleges that the act, under which the Maryland Telephone Company claims the right to do a lighting and power business in Baltimore, did not grant to the corporation any such right, and that if such right had been granted by it the Maryland Telephone Company has never made use of it, and by so doing has practically renounced the benefit of it. The telephone company contended that it had never renounced the benefits from the act of 1892, and that ever since 1896 it had conducted its telephone business, and had at all times asserted its rights to all the powers contained in the act of 1892. The principal question in the contention, according to the court, was the right of power invested in the Maryland Telephone Company under the act of 1892 of the Maryland assembly, and the court was of the opinion that the corporation had been accorded the power to engage in an electric lighting business in connection with its telephone business, and therefore sustained the demurrer filed to the bill of complaint.

THE SUIT OF THE BROOKFIELD GLASS COMPANY SUCCESSFUL—The Brookfield Glass Company, Brooklyn, N. Y., has been successful in its suit against the Elmer Glass Works, of Elmer, N. J., restraining the latter company from infringing a patented press owned and controlled by the former company. Some time ago a suit was brought by William Brookfield against the Novelty Glass Manufacturing Company, of Elmer, N. J., for infringement of the Kribs patent. The Novelty company contended that the Kribs patent was invalid, and that the press of the Novelty company did not infringe. The court decided against the Novelty company, holding that the patent was valid, and that the Novelty company had infringed. A decree was entered for a perpetual injunction and for an accounting against the Novelty company. This accounting is now proceeding. The property of the Novelty company was shortly after sold out under foreclosure, and the Elmer Glass Works organized. The Elmer Glass Works used two forms of press, which are designated as the Duffield press. The Brookfield Glass Company then instituted proceedings against the Elmer Glass Works, making a motion for a preliminary injunction restraining the Elmer Glass Works from using both forms of the press. The court directed that a preliminary injunction be issued against the Elmer Glass Works, restraining it from using the second form of the Duffield press. The court did not grant the preliminary injunction against the first form of the Duffield press, because there seemed to be some doubt about its infringement, and held that where there is any doubt as to an infringement the question must be left to be determined at the final hearing of a case.

ELECTRIC RAILWAYS.

SPRINGFIELD, OHIO—The Springfield & Xenia traction line has been sold to the bondholders represented by H. B. McGraw, of Cleveland, Ohio, for $225,600.

KNOXVILLE, TENN.—A building permit has been issued to the Knoxville Traction Company for an addition to its power-house, which it is estimated will cost $20,000 for the building alone.

RALEIGH, N. C.—At an adjourned meeting of the board of aldermen a franchise for the use of the streets of Raleigh for sixty years was granted to the Durham Passenger and Power Company.

BATTLE CREEK, MICH.—The Grand Rapids, Battle Creek & Inland Lakes Traction Company has filed its acceptance of the franchise offered by the city council. The franchise has been amended and an entirely different route will be taken.

LOCK HAVEN, PA.—A trolley line is being surveyed between Clearfield and Curwensville with a view of extending the line on through to DuBois. The work of constructing this line will begin as soon as spring opens. It is expected that it will be extended to Woodland and the Clearfield County home.

SAN MARCOS, TEX.—Judge B. G. Neighbors, of San Marcos, is authority for the statement that the construction of an electric line from San Marcos along the San Marcos river, touching at Martindale, Fentress, Staples, Prairie Lea and terminating at Luling, is reasonably assured. Outside capitalists are behind the plan.

WELLINGTON, KAN.—A. O. Boyle, president of the Arkansas Valley Interurban Railway Company, has filed a bond mortgage for $2,100,000, to secure the funds for construction. This company, together with the Kansas & Oklahoma company, has franchises in Wichita, Wellington, Winfield, Arkansas City and several small towns which the road will connect.

LITTLE ROCK, ARK.—S. J. Norman, secretary and treasurer of the North Arkansas Electric Railroad and Power Company, states that eighteen miles of grading has been done through Searcy and Newton counties, starting at Mount Hersey, and that the line has been surveyed for sixty-five miles. It is proposed to build the road for 132 miles instead of fifty miles, as at first planned. The terminus is not yet announced.

CHICAGO, ILL.—Articles have been filed by the Chicago & Southwestern Traction Company, the principal office of which is to be located in Chicago. The company purposes the construction of a road from Morris, in Grundy County, to Yorkville, in Kendall County. The capital stock is $400,000, and the incorporators, who are to constitute the first board of directors, are William T. Kopf, Charles A. Newton, Albert J. Claussen, Frederick W. Hill and Horace W. Nichols, Jr., all of Chicago.

BALLSTON, N. Y.—The Ballston Terminal Railroad, an electric freight line operating between Ballston and Middle Grove, a distance of twelve miles, has been sold under foreclosure proceedings. The property was bid in by Thomas F. Barrett, representing A. S. and A. N. Chandler, of Philadelphia, holders of the defendant company's bonds. The company was reorganized as the Eastern New York Railroad Company, with a capital stock of $100,000, and operation of the line will continue. The principal business of the road is supplied by eleven paper mills in the Kayaderosseras valley.

LEXINGTON, KY.—Master Commissioner Webb sold at public auction recently the franchises of the Bluegrass Consolidated Traction Company, which proposed to build interurban electric lines on numerous turnpikes throughout the Bluegrass section of the state. The company was incorporated by George B. Davis, of Detroit, Mich., with a capital stock of $7,000,000. Mr. Davis failed to build the line proposed, and his creditors brought suit against the company for a total sum of about $20,000. The assets of the company consisted of its franchises in Fayette, Clark, Woodford, Franklin, Madison, Jessamine and Montgomery counties and some railroad ties. The franchises were all bought by Clifford D. Bebee, of Detroit, for $2,457.

BOSTON, MASS.—The state railroad commissioners have authorized the consolidation of the Worcester & Southbridge, the Southbridge & Sturbridge and the Worcester, Rochdale & Charlton Depot street railway companies, the controlling in all of which has been acquired by the New York, New Haven & Hartford Railroad. The new system, which will be known as the Worcester & Southbridge Street Railway Company, has received permission to increase its capital stock by $100,000, to be used in purchasing the outstanding stock of the Southbridge & Sturbridge and Charlton Depot roads on a share-for-share basis. The original Worcester & Southbridge road and the Charlton Depot company went into the hands of receivers about a year ago, but were subsequently reorganized.

INDIANAPOLIS, IND.—The directors of the new Indianapolis & Ohio Valley Company, which was recently incorporated with a capital stock of $50,000, have elected officers. It is announced that work on that part of the proposed road between Rockport and Cannelton will be begun immediately. The line will be 150 miles in length. It will go from Indianapolis to Rockport, passing through Nashville, Bloomington, Bedford, Mitchell, Paoli, West Baden, French Lick, Jasper, Ferdinand, St. Meinrad, Evanston, Grand View, Troy and Tell City. The directors include J. H. Larimer, A. E. Fauve, M. E. Fauve and Butler Smith, all of Indianapolis, and Peter Backer, of Troy, Ind. The promoters say they have obtained options on the proposed right of way and that the farmers along the route are subscribing for stock and doing all they can to aid the project.

NEW COMPANIES.

NEW YORK, N. Y.—The Detroit Gas and Electric Fixture Company has been incorporated by J. M. Ehrlich, C. A. Cappock and H. J. Joel. The capital is $10,000.

NEW YORK, N. Y.—The Seaboard Electric Equipment Company has been organized by S. B. Smith, New York, and D. H. Patton and D. G. Patton, of Yonkers. The capital is $50,000.

WASHINGTON, D. C.—Herman G. Weinert, Charles L. Sharrow, Harry Pole and James T. Kinsler have organized the International Boat Steering Electric Company, capitalized at $25,000,000.

KOKOMO, IND.—The Kokomo Electric Construction Company has been incorporated. The capital stock is $20,000, and the directors are G. W. Norwood, C. O. Scott and George H. Martgolff.

JERSEY CITY, N. J.—The Rock Island Battery Company has been incorporated to engage in a general contracting business. The incorporators are L. B. Dailey, B. S. Moritz and J. M. Mitchell, of Jersey City.

ITHACA, N. Y.—The Davis-Brown Electric Company has been incorporated to deal in electrical supplies. The company is capitalized at $20,000, and the incorporators are William J. Davis, L. H. Brown and E. A. Denton.

JERSEY CITY, N. J.—The Rock Island Battery Company has been incorporated with a capital of $75,000, to engage in a general electrical business. The incorporators are Louis B. Daily, Stafford Mantz and Joseph M. Mitchell.

WEST HOBOKEN, N. J.—The General Light Supply Company has been incorporated by Ludwig Engel, Max Heyman and Aaron Smith, with a capital stock of $10,000. The company will deal in and manufacture lighting and heating apparatus.

NEW YORK, N. Y.—The Schaper Construction Material Company has been incorporated to deal in material for telephone and other electric lines. The capital stock is $25,000. John H. Schaper and George Schaper, of Brooklyn, and August R. Ermisch, of Long Island City, are the directors.

HARTFORD, CT.—The New England Electrical Supply Company, of Waterbury, which will handle all kinds of electrical supplies, has been incorporated with a capital stock of $25,000. Alden M. Young, of New York, and A. O. Shepardson and W. G. Morse, of Waterbury, are the incorporators.

MEMPHIS, TENN.—The Boardman Electrical Construction Company has been organized with F. E. Boardman as president and general manager, and J. H. Hart as vice-president. The new company has purchased the entire electrical construction branch of the Electrical Supply Company's business.

INDUSTRIAL ITEMS.

THE H. T. PAISTE COMPANY, Philadelphia, Pa., is calling attention to its specialties with a series of calendar blotters containing sayings from "Aleck, the Electrician."

THE NORTH ELECTRIC COMPANY, Cleveland, Ohio, is distributing bulletins No. 29 and No. 30, describing, respectively, "Divided Circuit Two and Four-Party Selective Magneto Telephones" and "Cut-in Station." These bulletins describe some new and valuable apparatus. The bulletins will be sent to interested parties upon request.

THE REPLOGLE GOVERNOR WORKS, Akron, Ohio, has recently improved its water-wheel governors in general efficiency and workmanship 100 per cent. It has a full line of new mechanical governors, from which can be selected a machine that will meet any of the requirements at present known in water-power development.

THE COMMERCIAL ELECTRIC SUPPLY COMPANY, 1007-1009 Market street, St. Louis, Mo., is distributing a daily reminder and pocket diary for 1905. It contains, in addition to the usual information included in such books, a number of tables of interest to electrical men, such as incandescent wiring tables, volts lost at different per cents of drop, etc.

THE MICA INSULATOR COMPANY, 218 Water street, New York city, announces that, owing to the advanced cost of materials used in the production of "Micanite," it is compelled to withdraw all its former prices. The company will be pleased to send its new price list for 1905 on request. Discounts and prices on special goods will also be furnished upon application.

THE CHARLES E. DUSTIN COMPANY, 11 Broadway, New York city, is distributing to its patrons a very useful blotter. The company announces that it has ready for delivery a number of direct-connected units, alternators, direct-current generators and motors, engines, boilers, street railway cars, and equipments. The company makes a specialty of electrical and steam machinery.

THE ILLINOIS STEEL COMPANY is about to begin an extension of its works, at Joliet, Ill., at a cost of $100,000 to accommodate the business of the Continuous Rail Joint Company of America. The latter company is a New Jersey corporation with headquarters at Newark, N. J. It has extensive works at Troy, N. Y., but has found its western business requires a plant nearer the centre of trade, and for that reason has entered into the arrangement with the Illinois Steel Company.

THE LE VALLEY VITAE CARBON BRUSH COMPANY, 125 East Forty-second street New York city, has issued a new catalogue descriptive and illustrative of the Le Valley Vitae carbon brush. This brush was the first introduced on the market as a permanent self-lubricating brush, and the company states that it is conceded by electricians generally to be the acme of perfection. Any machine, no matter how overloaded, will work satisfactorily with it. The brush is made in different grades, for all kinds of stationary machines.

THE HOLOPHANE GLASS COMPANY, 15 East Thirty-second street, New York city, and 211 Jackson Boulevard, Chicago, Ill., will be pleased to send its descriptive literature upon request. This company has recently produced a series of elaborate booklets concerning lighting and lighting effects. The Holophane Glass Company will unite its Chicago and New York offices on January 15, 1905, in the Glackner Building, West Broadway and Fulton street, New York city. It will occupy the eighth and ninth floors, and will carry there a large stock, to ensure prompt deliveries.

THE AMERICAN ELECTRIC TELEPHONE COMPANY, of Chicago, reports a very brisk demand for small exchange switchboards of the type usually known as private branch exchange switchboards. Four equipments of this kind have recently been shipped to Topeka, Kan., and one equipment to Fort Worth, Tex. Among the recent shipments of small exchange switchboards of the magneto-call type the following destinations are given: Lebanon, Ind., one 100-line switchboard; Berne, Ind., one 100-line switchboard; Waverly, Ill., one 100-line switchboard; Tallahassee, Fla., one 100-line switchboard; Atkins, Ark., one 100-line switchboard; Brookville, Kan., one 100-line switchboard; Hamilton, Ga., one 100-line switchboard.

THE H. W. JOHNS-MANVILLE COMPANY, New York, has just placed on the market two additions to its line of asbestos packings. These are known as "Kearsarge" spiral high-pressure piston and valve rod packing, and "International" hot water pump packing. The "Kearsarge" spiral packing is the "Kearsarge" asbestos and rubber-wound cloth coil packing, well known to the trade, put up in spiral form to meet the growing demand for that type of packing. It has proved its merits as an efficient and durable packing on piston and valve rods, against high pressure, high temperature, and high speed. The "International" is a specially prepared and treated packing for use on pumps handling water at high temperatures, and on piston and valve rods of engines against wet steam. This material has been tested under actual working conditions for over a year and has been found to be satisfactory in every respect for the service mentioned. The manufacturer has prepared attractive literature descriptive of these two packings which it will be glad to send to anyone interested.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY has been awarded the contract for two 1,000-kilowatt turbo-generator outfits for the Haverhill, Mass., Electric Company, to be used in lighting and power work in that city; also one 1,000-kilowatt outfit with exciter for the Springfield Electric Light Company, Springfield, Mass.; also a 300-kilowatt turbo-generator with exciter for the Northern Electric and Manufacturing Company, of Montreal. The Springfield Electric Light Company's contract also included two 500-kilowatt rotary converters, and four 300-kilowatt transformers. The company has closed a contract with the Ontario Power Company for an alternating-current generator, with a rated output of 10,000 horse-power at eighty-five per cent power-factor. The generator is of the revolving-field, two-bearing type, designed for direct connection to water-wheels; it generates three-phase current at 12,000 volts and twenty-five cycles, and runs at a speed of 187.5 revolutions per minute. Other apparatus included in the contract are twelve 3,000-kilowatt oil-insulated, water-cooled transformers, wound for 12,000 and 60,000 volts; two 375-kilowatt exciters, and complete switchboards. It has also received an order through its agents, Takata & Company, of Tokio, Japan, for thirteen direct-current generators, each of 62.5-kilowatt capacity, and thirteen spare armatures. Each generator will be driven by a 125-horse-power steam engine, and the thirteen engines will be supplied by the Westinghouse Machine Company. The Westinghouse Electric and Manufacturing Company has sold to the International Paper Company for use in its plant at Berlin, N. H., one 250-kilowatt alternating-current generator of the revolving armature type, three 40-horse-power alternating-current motors with switchboard, transformers, etc. It has also sold to the Detroit United Railway Company, of Detroit, Mich., a 1,500-kilowatt railway generator, and a 250-kilowatt booster set. These machines are in addition to four other large railway generators of an aggregate capacity of 5,000 kilowatts, which the Westinghouse company has already installed for the Detroit company. Other street railway contracts just closed by the Westinghouse company include fifty four-motor car equipments to be used by the Cleveland Electric Railway Company, of Cleveland, Ohio, for city and suburban service. The motors will be of the new Westinghouse type, 101-B. It has sold to the Syracuse Railroad Construction Company, Syracuse, N. Y., apparatus for equipment of the Rochester, Syracuse & Eastern Railroad. The contracts include two 1,500-kilowatt turbo-generator outfits which will generate current at 3,300 volts, three-phase and twenty-five cycles. Each turbo-generator will be furnished with a fifty-kilowatt exciter mounted on the turbine shaft. The equipment also includes two 500-kilowatt rotary converters, and six 400-kilowatt rotary converters; twenty-four transformers, with a total capacity of 6,500 kilowatts, a thirteen-panel switchboard for the main generating station, and three substation switchboards of five panels each, as well as protective and detail apparatus. Motor equipments included in the contract call for twelve quadruple equipments of Westinghouse 110-horse-power motors, as well as eight quadruple and two double equipments of motors of other sizes.